Ron Tremayne

12

125
September
1985

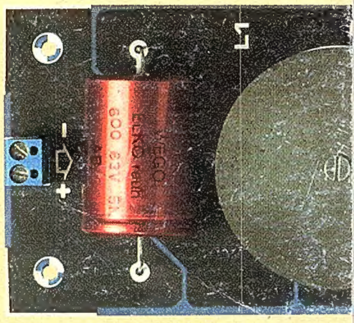
elektor electronics

£1.10

$3.95
R.R.P.

loudspeaker to KEF design

graphics card



intruder alarm

frequency standard

TTLs

74 SERIES

7400	0.30
7401	0.30
7402	0.30
7403	0.30
7404	0.36
7405	0.30
7406	0.40
7407	0.40
7408	0.30
7409	0.30
7410	0.30
7411	0.30
7412	0.30
7413	0.50
7414	0.70
7416	0.36
7417	0.40
7420	0.30
7421	0.60
7422	0.36
7423	0.36
7425	0.40
7426	0.40
7427	0.32
7428	0.43
7430	0.30
7432	0.36
7433	0.30
7437	0.30
7438	0.40
7439	0.40
7440	0.40
7441	0.90
7442A	0.70
7443A	1.00
7444	1.10
7445	1.00
7446A	1.00
7447A	1.00
7448	1.00
7450	0.36
7451	0.35
7453	0.38
7454	0.38
7460	0.55
7470	0.50
7472	0.45
7473	0.45
7474	0.50
7475	0.60
7476	0.45
7480	0.65
7481	1.80
7483A	1.05
7484A	1.25
7485	1.10
7486	0.42
7489	2.10
7490A	0.55
7491	0.70
7492A	0.70
7493A	0.55
7494	1.10
7495A	0.60
7496	0.80
7497	2.10
74100	1.90
74107	0.50
74109	0.75
74110	0.75
74111	0.55
74116	1.70
74118	1.10
74119	1.70
74120	1.00
74121	0.55
74122	0.70
74123	0.80
74125	0.65
74126	0.55
74128	0.55
74132	0.75
74136	0.70
74141	0.90
74142	2.50
74143	2.70
74144	2.70
74145	1.10
74147	1.70
74148	1.40
74150	1.75
74151A	0.70
74153	0.80
74154	1.40
74155	0.80
74156	0.90
74157	0.80
74159	1.75
74160	1.10
74161	0.80
74162	1.10
74163	1.10
74164	1.20
74165	1.10
74166	1.40
74167	4.00
74170	2.00
74172	4.20
74173	1.40
74174	1.10
74175	1.05
74176	1.00
74178	1.50
74179	1.50
74180	1.00
74181	3.40
74182	1.40
74184	1.80
74185A	1.80
74190	1.30
74191	1.30
74192	1.10
74193	1.15
74194	1.10
74195	0.80
74196	1.30
74197	1.10
74198	2.20
74199	2.20
74221	1.10
74251	1.00
74259	1.50
74265	0.80
74273	2.00
74276	1.40
74278	1.70
74279	0.90
74283	1.05
74285	3.20
74290	0.90
74293	0.90
74298	1.80
74351	2.00
74365A	0.80
74366A	0.80
74367A	0.80
74368A	0.70
74376	1.60
74390	1.10
74393	1.20
74490	1.10
74393	1.20
74490	1.40

74LS SERIES

74LS00	0.24
74LS01	0.24
74LS02	0.24
74LS03	0.24
74LS04	0.24
74LS05	0.24
74LS08	0.24
74LS09	0.24
74LS10	0.24
74LS11	0.24
74LS12	0.24
74LS13	0.34
74LS14	0.50
74LS15	0.24
74LS20	0.24
74LS21	0.24
74LS22	0.24
74LS24	0.50
74LS26	0.24
74LS27	0.24
74LS28	0.24
74LS30	0.24
74LS32	0.24
74LS33	0.24
74LS37	0.24
74LS38	0.24
74LS40	0.24
74LS42	0.50
74LS47	0.80
74LS48	0.90
74LS51	0.24
74LS54	0.24
74LS55	0.24
74LS73A	0.30
74LS74A	0.35
74LS75	0.45
74LS76A	0.36
74LS78	0.42
74LS83A	0.70
74LS85	0.75
74LS86	0.35
74LS90	0.48
74LS91	0.90
74LS92	0.35
74LS93	0.54
74LS95B	0.75
74LS96	0.90
74LS107	0.40
74LS109	0.40
74LS112	0.45
74LS113	0.45
74LS114	0.45
74LS122	0.70
74LS123	0.80
74LS124/629	1.40
74LS125	0.50
74LS126	0.50
74LS132	0.65
74LS133	0.50
74LS136	0.45
74LS138	0.55
74LS139	0.55
74LS145	0.95
74LS147	1.75
74LS148	1.40
74LS151	0.65
74LS152	2.00
74LS153	0.65
74LS154	1.60
74LS155	0.65
74LS156	0.65
74LS157	0.50
74LS158	0.65
74LS160A	0.75
74LS161A	0.75
74LS162A	0.75
74LS163A	0.75
74LS164	0.75
74LS165A	1.30
74LS166A	1.50
74LS168	1.30
74LS169	1.00
74LS170	1.40
74LS173A	1.00
74LS174	0.75
74LS175	0.75
74LS181	2.00
74LS183	1.90
74LS190	0.75
74LS191	0.75
74LS192	0.80
74LS193	0.80
74LS194A	0.75
74LS195A	0.75
74LS196	0.80
74LS197	0.80
74LS221	1.00
74LS240	0.90
74LS241	0.90
74LS242	0.90
74LS243	0.90
74LS244	0.80
74LS245	1.00
74LS247	1.10
74LS248	1.10
74LS249	1.10
74LS251	0.75
74LS253	0.75
74LS256	0.90
74LS257A	0.70
74LS258A	0.70
74LS259	1.20
74LS260	0.75
74LS261	1.20
74LS266	0.60
74LS273	1.25
74LS279	0.70
74LS280	1.90
74LS283	0.80
74LS290	0.80
74LS292	9.00
74LS293	0.80
74LS295	1.40
74LS297	9.00
74LS298	1.00
74LS299	2.20
74LS231	3.70
74LS324/624	3.50
74LS348	2.00
74LS352	1.20
74LS353	1.20
74LS356	2.10
74LS363	1.80
74LS364	1.80
74LS365	0.50
74LS366	0.50
74LS367	0.52
74LS368	0.50
74LS373	0.90
74LS374	0.90
74LS375	0.75
74LS377	1.10
74LS378	0.95
74LS379	1.40
74LS381	4.50
74LS390	0.60
74LS393	1.10
74LS395A	1.00
74LS399	1.40
74LS445	1.80
74LS465	1.20
74LS467	1.80
74LS540	1.00
74LS541	1.00
74LS608	7.00
74LS610	19.00
74LS612	19.00
74LS624	3.50
74LS626	2.25
74LS628	2.25
74LS629	1.40
74LS640	3.00
74LS640-1	3.00
74LS641	2.00
74LS642	2.50
74LS642-1	3.00
74LS643	2.50
74LS643-1	3.00
74LS644	3.50
74LS645	2.00
74LS645-1	4.00
74LS668	0.90
74LS669	0.90
74LS670	1.80
74LS682	2.50
74LS684	3.50
74LS687	3.50
74C922	6.50
74C923	6.50
74C925	6.50
74C926	6.50
74C928	6.50

4000 SERIES

4000	0.20
4001	0.24
4002	0.25
4006	0.70
4007	0.25
4008	0.60
4009	0.45
4010	0.60
4011	0.24
4012	0.25
4013	0.36
4014	0.60
4015	0.70
4016	0.36
4017	0.55
4018	0.60
4019	0.60
4020	0.80
4021	0.60
4022	0.70
4023	0.30
4024	0.48
4025	0.24
4026	0.90
4027	0.40
4028	0.60
4029	0.75
4030	0.35
4031	1.25
4032	1.00
4033	1.25
4034	2.50
4035	0.70
4036	2.50
4037	1.10
4038	1.00
4039	2.50
4040	0.60
4041	0.55
4042	0.50
4043	0.60
4044	0.60
4045	1.00
4046	0.60
4047	0.60
4048	0.55
4049	0.36
4050	0.35
4051	0.65
4052	0.60
4053	0.60
4054	0.80
4055	0.80
4056	0.85
4059	4.00
4060	0.70
4063	0.85
4066	0.40
4067	2.30
4068	0.25
4067	0.24
4068	0.25
4069	0.24
4070	0.24
4071	0.24
4072	0.24
4073	0.24
4075	0.24
4076	0.65
4077	0.25
4078	0.25
4081	0.24
4082	0.25
4085	0.60
4086	0.75
4089	1.20
4093	0.35
4094	0.90
4095	0.90
4096	0.90
4097	2.70
4098	0.75
4099	0.90
4501	0.36
4502	0.55
4503	0.36
4504	0.95
4505	3.60
4506	0.90
4507/4030	0.35
4508	1.20
4510	0.55
4511	0.55
4512	0.55
4513	1.50
4514	1.10
4515	1.10
4516	0.55
4517	2.20
4518	0.48
4519	0.32
4520	0.60
4521	1.15
4522	0.80
4526	0.70
4527	0.80
4528	0.65
4529	1.00
4531	0.75
4532	0.65
4534	3.80
4536	2.50
4538	0.75
4539	0.75
4541	0.90
4543	0.70
4551	1.00
4553	2.40
4555	0.36
4556	0.50
4557	2.40
4560	1.40
4566	1.40
4568	2.40
4569	1.70
4572	0.45
4583	0.90
4584	0.48
4585	0.60
4724	1.50
14411	7.50
14412	7.50
14416	3.00
14419	2.60
14490	4.20
14495	4.50
14500	6.50
14599	2.00
22100	3.50
22101	7.00
22102	7.00
40014	0.48
40085	1.20
40097	0.36
40098	0.40
40100	1.50
40101	1.25
40102	1.50
40103	2.00
40104	1.20
40105	1.50
40106	0.48
40107	0.55
40108	3.20
40109	1.20
40110	2.25
40114	2.25
40147	2.80
40163	1.00
40173	1.20
40174	1.00
40175	1.00
40192	1.00
40193	1.00
40194	1.00
40244	1.50
40245	1.50
40257	1.80
40373	1.80
40374	1.80
80C95	0.75
80C97	0.75
80C98	0.75

Full range of 74S & 74HC series in stock. Ask for full list.

zif sockets

24 pin	5.50
28 pin	7.00
40 pin	8.00

TTL & ECL

10116	70p
10231	350p

LINEAR I.Cs

AD7581	15.00
ADC0808	11.90
AM7910DC	25.00
AN103	2.00
AY1-5050	1.00
AY3-1350	3.50
AY3-8010	4.50
AY3-8910	4.00
AY3-8912	5.0
CA3019A	1.00
CA3028A	1.10
CA3046	0.70
CA3059	3.20
CA3060	3.50
CA3080E	0.70
CA3086	0.60p
CA3089E	2.10
CA3090AQ	3.75
CA3130E	0.90
CA3130T	1.30
CA3140E	0.45
CA3140T	1.00
CA3146	2.25
CA3160E	0.90
CA3161E	2.00
CA3162E	6.00
CA3189E	2.70
CA3240E	1.50
CA3280G	2.70
D7002	6.00
DAC1408-8	3.00
DAC0800	3.00
DAC0808	3.00
DG308	3.00
HA1366	1.90
ICL7106	6.75
ICL7611	8.95
ICL7650	4.00
ICL7660	2.50
ICL8038	4.00
ICM7216B	22.00
ICM7217	7.50
ICM7555	0.90
ICM7556	1.40
LC7120	3.00
LC7130	3.00
LC7431	3.50
LC7137	3.50
LF347	1.20
LF351	0.60
LF353	0.90
LF355	0.90
LF356N	0.95
LF357	1.00
LM10CLH	4.50
LM301A	0.30
LM307	0.45
LM308CN	0.75
LM310	2.25
LM311	0.60
LM318	1.50
LM319	1.80
LM324	0.45
LM334Z	1.15
LM335Z	1.30
LM336	1.60
LM339	0.40
LM348	0.60
LM349CH	3.60
LM358P	0.50
LM377	3.00
LM380N-8	1.50
LM380N	1.50
LM381AN	1.70
LM382	2.00
LM383	3.25
LM384	2.20
LM386N-1	1.00
LM387	2.70
LM389	1.80
LM391	1.80
LM392N	1.10
LM393	0.85
LM394CH	4.00
LM709	0.35
LM/10	0.48
LM711	1.00
LM723	0.60
LM725CN	3.00
LM733	0.65
LM741	0.22
LM747	0.70
LM748	0.30
LM1011	4.80
LM1014	1.50
LM1801	3.00
LM1830	2.50
LM1871	3.00
LM1872	3.00
LM1886	5.50
LM1889	3.50
LM2917	3.00
LM3302	0.90
LM3900	0.80
LM3909	1.00
LM3911	1.80
LM3914	3.50
LM3915	3.40
LM3916	3.40
LM13600	1.50
M51513L	2.30
M51516L	4.50
MB3712	2.00
MC1310	1.50
MC1413	0.75
MC1458	0.45
MC1495L	3.00
MC1496	0.70
MC3340	2.00
MC3401	0.70
MC3403	0.65
MF10CN	3.00
MK50240	9.00
MK50398	7.90
ML920	5.00
ML922	4.00
MM66221A	3.00
NE531	1.20
NE555	0.22
NE556	0.60
NE564	4.00
NE565	1.20
NE566	1.50
NE567	1.25
NE570	4.00
NE571	2.50
NE592	0.90
NE5532P	1.50
NE5533P	1.60
NE5534P	1.20
NE5534AP	1.50
OP-07EP	5.00
PLL02A	5.00
RC4136	0.55
RC4151	2.00
RC4195	1.50
RC4558	0.55
S566B	2.20
S50240	9.00
SAA1900	16.00
SFF96364	8.00
SL490	3.00
SN76033N	3.00
SN76489	4.00
SN76495	4.00
SN76660	1.20
SPO256AL2	7.00
TA7120	1.20
TA130	1.40
TA7204	1.50
TA7205	0.90
TA7222	1.50
TA7310	1.50
TBA231	1.20
TBA800	0.80
TBA810	0.90
TBA820	0.90
TBA820M	0.75
TBA920	2.00
TBA950	2.25
TC9109	5.00
TCA210	3.50
TCA220	3.50
TCA940	1.75
TDA1010	2.25
TDA1022	4.00
TDA1024	1.10
TDA1170S	3.00
TDA2002	3.25
TDA2003	1.90
TDA2004	2.40
TDA2006	3.20
TDA2020	3.20
TDA2030	2.50
TDA2591	4.00
TDA3810	7.50
TDA7000	3.50
TEA1002	7.00
TL061CP	0.40
TL062	0.60
TL064	0.90
TL071	0.40
TL072	0.70
TL074	1.10
TL081	0.35
TL082	0.55
TL083	0.75
TL084	1.00
TL094	2.00
TL170	0.50
TL430C	1.20
UAA1003-9	9.35
UA759	3.20
UA2240	1.20
UAA170	1.70
UCN4801A	5.50
ULN2003A	0.75
ULN2004A	0.75
LN2068	2.90
ULN2802	1.90
ULN2803	1.80
ULN2804	1.90
UPC575	2.75
UPC592H	2.00
UPC1156H	3.00
UPC1185H	5.00
XR210	4.00
XR2206	4.00
XR2207	3.75
XR2211	5.75
XR2216	6.75
XR2240	1.20
ZN404	1.20
ZN414	0.80
ZN419P	1.75
ZN423E	1.30
ZN424E	1.30
ZN425E8	3.50
ZN426E8	3.00
ZN427E8	6.00
ZN428E8	4.50
ZN429E8	2.25
ZN447E	9.50
ZN449E	3.00
ZN450E	7.50
ZN459CP	3.00
ZN1034E	2.00
ZN1040	6.60
ZNA134J	23.00
ZNA234E	9.50
8703CJ	12.00

CPU's

68B09E	16.00
68000-L8	36.00
8035	3.50
8039	4.20
8080A	4.20
8085A	3.00
8086	22.00
8088	17.50
8741	16.00
8748	18.00
TMS1601	12.00
TMS9980	14.50
TMS9995	12.00
WD55	14.50
Z80	2.80
Z80A	3.25
Z80B	7.00
Z80H	7.50

SUPPORT DEVICES

2651	12.00
3242	8.00
3245	4.50
6520	3.00
6522	3.50
6552	2.50
6522A	5.50
6532	4.80
6551A	5.25
6821	1.50
68B21	2.20
6829	12.50
6840	3.75
68B40	6.00
6850	1.60
68B50	2.50
6852	2.50
6854	6.50
68B54	8.00
6875	5.00
8154	8.50
8155	3.80
8156	3.80
8205	2.25
8212	2.20
8216	1.60
8224	P.O.A.
8226	4.25
8228	4.50
8243	2.60
8250	9.50
8251A	3.25
8253C-5	3.50
8255AC-5	3.00
8256	18.00
8257C-5	4.00
8259C-5	4.00
8275	29.00
8279C-5	4.80
8283	4.00
8282	4.50
8284	4.60
8287	4.25
8288D	11.00
8755A-0/1/2/9	18.00
TMS4500	14.00
TMS9901	5.00
TMS9902	5.00
TMS9903	25.00
TMS9911	18.00
TMS9914	14.00
Z80B10	5.00
Z80P1O	2.40
Z80AP1O	2.75
Z80CTC	2.50
Z80ACTC	2.75
Z80DART	6.50
Z80ADART	8.00
Z80ADMA	7.50
Z80ASIO	7.00

CPU's

1802CE	6.50
2650A	10.50
6502	3.50
65C02	12.00
6502A	5.50
6502B	8.00
6800	2.50
6802	3.00
6809	6.50
6809E	12.00
68B09	12.00

RAMS

2016-150	4.00
2101	4.00
2102	2.50
2107B	5.00
2111A-35	4.00
2114-3	2.50
2147	4.00
4116-15	4.50
4116-20	1.50
4118-3	5.00
41256-20	10.00
4164-15 (TI)	5.00
4164-15	3.00
4164-20	3.00
4416-15	4.00
4532-20	2.50
4816AP-3	2.00
5101/5501	3.70
5514/5114	4.50
5516	5.50
6116P-3	3.50
6116LP-3	4.00
6264LP-15	6.00
6810	1.60
74S189	2.25
74S201	3.50
74S289	2.25
93415	6.00
93L422	9.50
93425	6.00

ROMS/PROMS

28L22	4.00
24S10	2.50
18S030	2.00
18SA030	2.00
74S188	1.80
74S287	2.25
74S288	1.80
74S387	2.25
82S23	1.50
82S123	1.50
82S129	1.75

EE PROM

2816-30 2K × 8	30.00
9306 256 bits (16 × 16)	4.00

EPROMS

2516 + 5V	3.50
2516-35	5.50
2532	4.50
2532-30	5.50
2564	8.00
2708	4.00
2716 + 5V	3.50
2716-35	5.50
2732	4.50
2732A-2	9.00
2732A-30	6.00
2732A-35	5.00
2764-25	2.60
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MC6845SP	6.50
MC6847	6.50
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TMS9928	10.00
TMS9929	10.00

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1.8432 MHz	2.25
2.00 MHz	2.25
2.45760 MHz (S)	2.00
2.5 MHz	2.50
2.662 MHz	2.50
3.12 MHz	1.75
3.276 MHz	1.50
3.5795 MHz	1.00
4.00 MHz	1.40
4.194 MHz	1.50
4.43 MHz	1.00
4.608 MHz	2.50
4.9152 MHz	2.00
5.000 MHz	1.50
5.068	1.75
6.00 MHz	1.40
6.144 MHz	1.40
7.00 MHz	1.50
7.168 MHz	1.75
8.00 MHz	1.50
8.867 MHz	1.75
10.00 MHz	1.75
10.50 MHz	2.50
10.70 MHz	1.50
11.00 MHz	3.00
12.00 MHz	1.50
14.00 MHz	1.75
14.318 MHz	1.60
14.756MHz	2.50
15.00 MHz	2.00
16.00 MHz	2.00
17.734 MHz	1.50
18.00 MHz	1.50
18.432 MHz	1.50
19.969 MHz	1.50
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24.000 MHz	1.50
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DS8838	2.25
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MC4044	5.50
MC14411	9.00
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ULN2003	0.75
75107	0.90
75108	0.90
75109	1.20
75110	0.90
75112	1.60
75113	1.20
75114	1.40
75115	1.40
75121	1.40
75122	1.40
75150P	1.20
75154	1.20
75159	2.20
75160	5.00
75161	3.50
75162	4.00
75172	3.00
75182	0.90
75188	0.60
75189	0.60
75365	1.50
75451	0.50
75452	0.50
75453	0.70
75454	0.70
75480	1.50
75491	0.65
75492	0.65
8T26	1.20
8T28	1.20
8T95	1.20
8T96	1.20
8T97	1.20
8T98	1.20
81LS95	1.40
81LS96	2.20
81LS97	1.40
81LS98	2.20
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9602	3.00
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9637AP	1.60
9638	2.00

TELETEXT DECODER

SAA5020	6.00
SAA5030	7.00
SAA5041	16.00
SAA5050	9.00

UARTS

AY-3-1015P	3.00
AY-5-1013P	3.00
COM8017	3.00
IM6402	4.50

ATTENTION ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE

VOLTAGE REGULATORS - 1A FIXED VOLTAGE PLASTIC TO220

+ VE			− VE	
5 V	7805	0.45	7905	0.50
6 V	7806	0.50	7906	0.50
8 V	7808	0.50	7908	0.50
12 V	7812	0.45	7912	0.50
15 V	7815	0.50	7915	0.50
18 V	7818	0.50	7918	0.50
24 V	7824	0.50	7924	0.50

1A FIXED VOLTAGE PLASTIC TO92

5 V	78L05	0.30	15 V	78L15	0.30
6 V	78L06	0.30	5 V	79L05	0.45
8 V	78L08	0.30	12 V	79L12	0.50
12 V	78L12	0.30	15 V	17L15	0.50

OTHER REGULATORS / SWITCHING REGULATORS

OTHER REGULATORS		SWITCHING REGULATORS	
LM309K	1.40	ICL7660	2.50
LM323K	3.50	SG3524	3.00
78HO5KC		TL494	3.00
5 A 5 V	5.75	TL497	3.00
78H12	6.40	78S40	2.50
78PO5	9.00	RC4195	1.50

VARIABLE REGULATORS

LM305AH	2.50	LM723N	0.50
LM317T	1.50	78HGKC	6.50
LM317K	2.40	78GUIC	2.25
LM337T	2.25	79HGKC	6.75
LM350T	4.00	79GUIC	2.50
LM396K	15.00	79MGT2C	1.40

OPTO-ISOLATORS

ILD74	1.30	TIL112	0.70
ILQ74	2.20	TIL113	0.70
MCT26	1.00	TIL116	0.70
MCS2400	1.90	6N137	3.60
MOC3020	1.50	6N139	1.75
TIL111	0.70		

DISPLAYS

FND357	1.00	MAN6610	2.00
FND500/TIL730	1.00	NSB5881	5.70
FND507/TIL729	1.00	TIL311	6.50
MAN74/DL704	1.00	TIL729	1.00
MAN71/DL707	1.00	TIL730	1.00
MAN3640	1.75	MAN8910	1.50
MAN4640	2.00		

DISPLAY DRIVERS

9368	4.50	ULN2004	0.90
9370	4.50	ULN2068	2.90
LM3914	3.50	ULN2802	1.90
LM3915	3.50	ULN2803	1.80
LM3916	3.50	ULN2804	1.90
UDN6118	3.20	75491	0.70
UDN6184	3.20	75492	0.70
ULN2003	0.90		

OTHERS

2N5777	0.50	ORP12	1.20
BPX25	1.80	ORP60	1.20
BPW21	2.80	ORP61	1.20
OCP71	1.80	SFH205	1.00

SCRS

1A 50V	70p
5A 400V	50p
8A 600V	140p
16A100V	200p
C106D	45p
MCR101	36p
T1C44	36p
2N3525	130p
2N4444	140p
2N5060/4	40p

ZENERS

2.7V-33V	
400MW	9p
1W	15p

TRIACS

Plastic	
3A 400V	60p
6A 400V	70p
6A 500V	90p
8A 400V	75p
8A 500V	95p
12A500V	105p
16A500V	130p
T 2800D	130p
T1206D	50p
T1226D	70p

DISCRETE DISPLAYS LEDS

125"	
RED TIL209	0.12
GREEN TIL211	0.16
YELLOW TIL212	0.20
Rect LEDs (R/G/Y)	0.30
CXQ (Bi Colour	1.00
10 LED Bargraph: Red	2.25
Green	2.25
0.2"	
TIL220	0.15
TIL222	0.18
TIL226	0.22
TIL32	0.55
TIL78	0.55
TIL31B	1.20
TIL81	1.20
TIL100	0.75

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	9p	18 pin	16p	24 pin	24p
14 pin	10p	20 pin	18p	28 pin	26p
16 pin	11p	22 pin	22p	40 pin	30p

WIRE WRAP SOCKETS BY TEXAS

8 pin	30p	18 pin	50p	24 pin	75p
14 pin	42p	20 pin	60p	28 pin	100p
16 pin	45p	22 pin	65p	40 pin	130p

Turned Pin Low Profile Sockets

8 pin	20p	16 pin	30p	20 pin	40p	28 pin	65p
14 pin	25p	18 pin	35p	24 pin	55p	40 pin	90p

TRANSISTORS

BC107/8	18p
BC109B	18p
BC109/C	20p
BC141	40p
BC161	40p
BC177	30p
BBC179	30p
BC182/L	15p
BC184/L	20p
BC212/L	16p
BC213/L	16p
BC214/L	18p
BC327	16p
BC338	16p
BC477	36p
BBC516/7	50p
BBC547/B	20p
BBC548C	16p
BC557B	18p
BC558B	18p
BC559C	24p
BCY71	36p
BCY72	30p
BD131	75p
BD132	80p
BD135	40p
BD136	40p
BD139	40p
BD241B	75p
BD242B	75p
BD244B	40p
BF256B	50p
BF257/8	40p
BF259	40p
BF337	36p
BFR80/81	32p
BFY50/51	30p
BFY52	30p
BFY90	90p
MJ2501	225p
MJ2955	90p
MJ3001	225p
MJE2955	150p
MJE3055	125p
MPF102	40p
MPF103/4	40p
MPF105	40p
MPSA12	50p
TIP29C	40p
TIP31B	40p
TIP31C	45p
TIP32C	45p
TIP33C	80p
TIP35C	140p
TIP36C	150p
TIP41C	50p
TIP42A	60p
TIP42C	65p
TIP47	90p
TIP54	160p
TIP55	180p
TIP125	70p
TIP2955	90p
TIP3055	70p
2N2160	350p
2N2219A	30p
2N2222A	30p
2N2484	30p
2N2646	50p
2N2905A	30p
2N3053	36p
2N3054	60p
2N3055	55p
2N3442	140p
2N3702 3	25p
2N3704 5	25p
2N3706 7 8	25p
2N3773	200p
2N3819	40p
2N3866	90p
2N3904 6	22p
2N4871	50p
2N5245	40p
2N5457 8	30p
2N5459	30p
2N5485	45p
2N5883	375p
2N6027	30p
3N128	200p
3N140 1	200p
40673	90p

IDC CONNECTORS

	10 way	20 way	26 way	34 way	40 way	50 way
Header Plug	90p	145p	175p	200p	220p	235p
Receptacle	85p	125p	150p	160p	190p	200p
Edge Conn.	120p	195p	240p	320p	340p	390p

EURO CONNECTORS

	Plug	Socket
DIN 41612 2 - 32-way	300p	350p
angled 2 - 32-way	350p	400p
angled 3 - 32-way	400p	—
(for 2 - 32 way specify a - bor a - c)		
DIN 41617 21-way	160p	165p
DIN 41617 31-way	170p	170p
DIN 41612		
2 × 32 way St Pin	230p	275p
2 × 32 way Ang Pin	275p	320p
3 × 32 way St Pin	260p	300p
3 × 32 way Ang Pin	375p	400p
1 DC Skt A + B	425p	
A + C	425p	

For 2 × 32 way please specify spacing (A + B, A + C)

DIODES

BY127	12p
OA47	10p
OA90	9p
OA91	9p
OA95	9p
OA200	9p
OA202	10p
IN914	4p
IN4148	4p
IN4001/2	5p
IN4003/4	5p
IN4006/7	7p
IN5401/2	12p
IN5403/4	14p
IS920	9p

BRIDGES

1A50V	19p
1A100V	20p
1A600V	30p
2A50V	30p
2A100V	35p
2A400V	45p
3A200V	60p
4A100V	95p
4A400V	100p
6A50V	80p
6A100V	100p
6A400V	120p
8A100V	150p
10A100V	180p
10A400V	200p

MIN. D CONNECTORS

	9 way	15 way	25 way	37 way	50 way
		MALE			
solder	60p	85p	1.25p	2.40p	4.00p
angled	1.20p	1.80p	2.40p	3.50p	—
		FEMALE			
solder	90p	1.30p	1.95	2.90p	5.00p
angled	1.60p	2.10p	2.90p	4.40p	—
hood (top/side entry)	90p	85p	90p	1.00p	—

25 way Centronix Type Conn. .... 5.50 pounds
37 way Centronix Type Conn. .... 5.50 pounds
IDC 25 way plug 3.85p Socket 4.50p.

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elektor electronics

September 1985
Volume 11 — Number 125

This month's cover shows the PL301 high-quality loudspeaker designed by KEF Electronics Ltd of Maidstone. The PL301 is a passive three-way system of unusual shape that is designed to handle up to 200 W of music power over the frequency range 35 Hz...20 kHz. The enclosure is free of resonances, which results in a neutral, uniform sound reproduction with tightly controlled bass performance.

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With burglaries on the increase everywhere, there are millions of people wanting to protect their property. This article suggests one means of doing so.

solid-state relay 28
An alternative to the electromagnetic relay for switching mains-operated ohmic loads of up to 600 watts.

PL301 32
To really enjoy music, you need the best possible loudspeaker. At the price, this KEF Electronics design is second to none.

high-resolution colour graphics card 50
The graphics card fitted to many computers is often so basic that powerful programs are needed to control it. This new series of articles offers an alternative — and better — way of meeting your graphics requirements.

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Regular cleaning of video cassette recorders, particularly the recording and playback heads, is essential to ensure optimum picture and sound quality.

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- windmeter
- high-resolution colour graphics card — 2
- sound rotator
- stage lighting
- marine computer
- telesoftware

BBC Micro Computer System
OFFICIAL DEALER

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BBC Model B	£299	(a)
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BBC Model B + Econet	£335	(a)
BBC Model B + Econet + DFS	£399	(a)
ACORN 10Mbyte Hard Disc	£1300	(a)
BBC Dust Cover	£4	(d)
BBC Carrying Case	£12	(b)

UPGRADE KITS

1.2 O/S Rom£7.50 (d)
Acorn DFS Kit £80 (d) DNFS Rom.£17.50 (d)
Econet Kit £55 (d) 4816AP RAM£1.50 (d)
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4816AP Memory upgrade RAM (each) £2.00

ACORN ADD-ON PRODUCTS:

Z80 2nd Processor	£265	(a)
6502 2nd Processor	£175	(b)
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IEEE Interface	£280	(b)
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VIEW	£48	(c)
HI VIEW	£52	(c)
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WORDWISE	£34	(d)
WORDWISE PLUS	£49	(d)

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Please write or telephone for details of other ROMs available

In addition to products listed above we stock a wide range of BBC peripherals including: TORCH UNICORN products, GRADUATE the add on that makes the BBC micro IBM compatible, SMARTMOUTH speech synthesiser, TIME WARP Real Time Clock, Colour Graphics Plotter, Graphics Tablet, Video Digitiser, Eprom Programmer etc.
Large selection of business, pleasure and education software including CPM software for the Acorn Z80.
For detailed specification of any of the above equipment please write or telephone.

DISC DRIVES

Single Drives:

		With integral psu:	
1 × 100K 40T SS :TS100	£85 (b)	PS100	£120 (b)
1 × 400K 80/40T DS :TS400	£125 (b)	PS400	£145 (b)

Dual Drives: (with integral psu)

Stacked Version:		Plinth Versions:	
PD200 2 × 100K 40T SS	£190 (a)	PD200P	£215 (a)
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The mechanisms are 80 track double sided and are capable of both single and double density operation.

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BT APPROVED MODEMS

MIRACLE ES2000:
The ultimate world standard modem covering all common BELL and CCITT standards upto 1200 Baud. Allows communication with virtually any computer system in the world. The optional AUTO DIAL and AUTO ANSWER boards enhance the considerable facilities already provided on the modem. Mains powered. £129 (b) Auto Dial Board/Auto Answer Board £30 (c) each (awaiting BABT approval). Software lead £4.50

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BBC to Modem data lead £7

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Please add carriage 50p unless indicated as follows:
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PROJECTS:

Junior Computer Kit	£86 (b)
Housekeeper kit	£58 (b)
Elekterminal Kit (1980)	£50 (b)
ASCII Keyboard kit	£75 (b)
J C Books 1, 2, 3, & 4	£6.90 (c) ea
Universal Terminal (6502) Kit	£75 (b)
Elekterminal Kit (1983)	£70 (b)

PRINTERS

EPSON RX80T+ **£210** (a); RX80FT+ **£220** (a); RX100+ **£345** (a); FX80+ **£315** (a); FX100+ **£430** (a); LX80NLQ **£242** (a); JX80 Colour **£499** (a) KAGA TAXAN: KP810 **£245** (a); KP910 **£339** (a); BROTHER: HR15 **£325** (a); JUKI 6100 **£325** (a).

ACCESSORIES

BUFFALO 32K Buffer for Epson printers **£99** (d); FX80 plus sheet feeder **£129** (b); EPSON Serial Interface: 8143 **£28** (b); 8148 with 2K buffer **£57** (b).
EPSON Paper Roll Holder **£17** (b); FX80 Tractor Attach **£37** (b); RX/FX80 Dust Cover **£4.50** (d); LX80 Tractor Unit **£20** (c).
EPSON Ribbons: MX/RX/FX80 **£5**; MX/RX/FX100 **£10** (d); LX80 **£6** (d);
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BROTHER HR15: Sheet Feed **£189**; Ribbons - Carbon or Nylon **£4.75**; Multistrike **£5.50** (d); 2000 Sheets Fanfold with extra fine perf. 9.5" - **£13.50**; 15" **£17.50** (b).
BBC Parallel Lead **£8**; Serial Lead **£7** (d).

MONITORS

ALL MONITORS SUPPLIED WITH LEAD FOR THE BBC

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1431 Std Res **£185** (a);	1431AP std Res PAL/Audio **£205** (a);
1451 Med Res **£240** (a);	1451AP Med Res PAL/Audio **£280** (a);
1451DQ3 Med Res for SINCLAIR QL **£239** (a)	
1441 Hi Res **£389** (a)	Plinth for Microvitec 14" **£8.50** (b)

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Microvitec Monitors with Dual TTL/Linear inputs are also available.

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Kaga KX1203A Amber Screen Hi Res Monitor **£105** (a)
PHILIPS DGD Hi Res Green Screen: **£68** (a)
Swivel Stand for Kaga Green with digital clock: **£22.50** (b)
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Summer clouds to fade away?

The world's electronics industries continue to suffer through a growth that is much slower than expected earlier this year. In many sectors demand is just a little faster than stagnancy and this is reflected in the performance figures of electronics concerns at both sides of the Atlantic. Throughout the summer, lower profits than last year, redundancies, and shut-downs have continued to dominate the news.

This depressing state of the market is the aftermath of the highly optimistic forecasts in the home computer markets last year. Dealers and manufacturers alike had then not yet realized that home computer buyers had become increasingly aware that there is little you can do with a home computer that cannot be done more easily, more quickly, and more cheaply with pencil and paper.

Throughout the summer, virtually all electronics manufacturers reported or forecast slow growth accompanied by a drop in earnings for the first quarter of the current financial year, and almost all said that the setback was primarily due to unfavourable developments in the semiconductor market. A giant like Philips has already said to fear "a grim second quarter", mainly caused by the poor performance of its American off-shoot Signetics Corporation, although losses by its Grundig associate were also a depressant on their forecast. Here in Britain, the problems in the semiconductor market were highlighted when Thorn-EMI reported a dramatic fall in net profits from £87 million to £33 million in 1984/85, resulting in the resignation of their chairman, Mr Peter Laister. Thorn-EMI's problems, too, were mainly caused by the poor performance of their semiconductor subsidiary Inmos, although their Ferguson television division was also in the red.

And yet, amidst all the gloom, there are signs that at least some of the cloud may begin to fade away soon. Most analysts reckon — and dealers and manufacturers generally agree — that, in Europe at least, although demand for home computers will go on declining, sales of business computers (generally accepted to be systems costing more than £2000) will continue to grow.

The intriguing question, providing the pundits are right, is, of course, what will happen next year when the new 32-bit micros will hit the market. Will there be enough software to ensure a favourable reception of these new machines? If so, how badly will the sales of 16-bit systems be affected? And will makers and dealers then attempt to prop up sales of the older machines through price cutting? Whatever the answers, they will not please everybody.

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UPC575	275
UPC1025H	375
UPC1156H	295
UPC1181	425
UPC1182	425
UPC1366	195
XR2206	375
XR2207	400
XR2211	575
XR2216	675
XR2266	360
ZN414	80
ZN423E	130
ZN424E	130
ZN425E	595
ZN426E	300
ZN427E	600
ZN428E	450
ZN429E	240
ZN459	245
ZN1034E	200
ZN1040E	665
ZNA234E	925

TRANSISTORS

AD142	120
AD149	79
AD161	42
AD162	42
AF118	80
AF139	40
AF239	55
BC107	12
BC107B	14
BC108	12
BC108B	14
BC108C	14
BC109	12
BC109B	14
BC109C	14
BC114/5	30
BC117/8	25
BC137/9	40
BC140	38
BC142/3	38
BC147	12
BC147B	15
BC148	12
BC148B	15
BC149	12
BC149C	15
BC153/4	30
BC157/8	14
BC159	11
BC160	46
BC167A	14
BC168C	12
BC169C	12
BC170	20
BC171/2	12
BC173	15
BC177/8	16
BC179	20
BC181	30
BC182/3	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC186/7	28
BC212	10
BC212L	12
BC213	10
BC213L	12
BC214	10
BC214L	12
BC237/8	15
BC256B	35
BC307B	15
BC308	16
BC318	30
BC327/8	15
BC337/8	15
BC441/61	34
BC477	40
BC516/7	40
BC547/8	12
BC549C	15
BC556/7	15
BC558/9	15
BCY41/42	30
BCY58/59	36
BCY70/71	18
BCY72/78	28
BD121	96
BD124	115
BD131/32	65
BD133	70
BD135	46
BD136/37	40
BD138/39	40
BD140	40
BD158	68
BD205/6	110
BD245	65
BD378	70
BD434	70
BD517	75
BD645	80
BD695/96	15
BF115	45
BF154/8	30
BF167	35
BF173/77	35
BF178/79	40
BF184/5	38
BF194/5	12
BF198/9	18
BF200	80
BF224A	40
BF224B	40
BF245	50
BF256A	45
BF256B	50
BF257/8	32
BF259	40
BF275	55
BF336/7	35
BF494/5	40
BFR39/40	25
BFR41/79	25
BFR80/81	25
BFR98	106
BFX29	35
BFX81	45
BFX85/6	35
BFY50/51	30
BFY52	30
BFY53	35
BFY55/6	35
BFY64	40
BFY81	120
BFY90	80
BFY39	50
BSX20	30
BSX26/29	45
BSY26	35
BSY95	35
BU105	180
BU205	190
BU206	200
BU208	200
BUY69C	225
MJ2955	90
MJE170	150
MJE180	150
MJE340	54
MJE370	100
MJE371	100
MJE520	96
MJE521	96
MJE2955	99
MJE3055	70
MPF102	40
MPF103/4	30
MPF105	30
MPF106	40
MPSA05	30
MPSA08	30
MPSA12	32
MPSA55	30
MPSA56	30
MPSA70	40
MPSU02	58
MPSU05	60
MPSU06	60
MPSU52	65
MPSU55	60
MPSU56	60
TIP29A	32
TIP29C	38
TIP30A	35
TIP30C	37
TIP31A	38
TIP31B	39
TIP31C	45
TIP32A	43
TIP32C	45
TIP33A	70
TIP33C	75
TIP34A	85
TIP34C	105
TIP35A	120
TIP35C	130
TIP36A	130
TIP36C	140
TIP41A	50
TIP41B	52
TIP42A	55
TIP42B	58
TIP120	70
TIP121/2	73
TIP141/2	120
TIP147	120
TIP2955	70
TIP3055	70
TIS44/5	45
TIS88A	50
TIS90/91	30
UC734	65
VK1010	99
VN10KM	70
VN46AF	95
VN66AF	110
VN88AF	120
VN89AF	120
ZTX300	13
ZTX301/2	20
ZTX303	25
ZTX304	17
ZTX314	25
ZTX326	30
ZTX341	30
ZTX451	23
ZTX500	14
ZTX501/2	15
ZTX503	18
ZTX531	25
ZTX550	25
2N697	23
2N698	40
2N699	48
2N707a	25
2N918	40
2N1131/2	40
2N1671b	160
2N2160	325
2N2219a	28
2N2220a	26
2N2221a	26
2N2222	25
2N2368	25
2N2369A	18
2N2483/A	27
2N2646	46
2N2904/5	28
2N2907	28
2N2926	10
2N3053	25
2N3055	50
2N3614	180
2N3702/3	10
2N3819	35
2N3820	60
2N3822	60
2N3904	18
2N3906	18
40673	75

74 HC

HC00	55
HC02	55
HC04	55
HC08	55
HC10	55
HC20	55
HC32	55
HC42	135
HC51	55
HC74	70
HC86	60
HC107	70
HC109	75
HC139	120
HC153	135
HC160	35
HC161	135
HC164	135
HC165	270
HC173	120
HC174	120
HC175	120
HC240	195
HC241	195
HC242	135
HC244	195
HC245	195
HC259	270
HC373	225
HC374	225
HC393	225
HC640	240
HC645	240

TTL74

7400	25
7401	25
7402	25
7403	25
7404	30
7405	30
7406	40
7407	40
7408	25
7409	25
7410	25
7411	25
7412	25
7413	40
7414	60
7416	35
7417	35
7420	25
7421	50
7422	35
7423	35
7425	35
7426	40
7427	35
7428	35
7430	25
7432	30
7433	30
7437	30
7438	40
7440	30
7441	90
7442	65
7443	100
7444	100
7445	110
7446	110
7447	95
7448	110
7450	30
7451	30
7453	35
7454	35
7460	30
7470	50
7472	50
7473	50
7474	45
7475	55
7476	45
7480	60
7481	175
7482	100
7483	100
7484	110
7485	100
7486	40
7489	200
7490	55
7491	70
7492	110
7493	50
7494	100
7495	60
7496	75
7497	200
74100	60
74104	70
74105	70
74107	45
74109	70
74110	55
74111	55
74116	160
74118	100
74119	160
74120	90
74121	45
74122	65
74123	75
74125	60
74126	55
74128	55
74132	70
74136	65
74141	85
74142	235
74143	250
74144	250
74145	100
74147	160
74148	130
74150	170
74151	60
74153	70
74154	130
74155	75
74156	90
74157	75
74159	170
74160	100
74161	100
74162	100
74163	100
74164	110
74165	100
74166	130
74167	300
74170	190
74172	400
74173	130
74174	100
74175	100
74176	100
74177	110
74178	130
74179	130
74180	100
74181	300
74182	120
74184	170
74185	170
74190	120
74191	120
74192	120
74193	120
74194	100
74195	75
74196	120
74197	100
74198	200
74199	200
74221	150
74246	130
74247	120
74248	145
74249	175
74251	90
74259	150
74265	260
74273	180
74276	130
74278	160
74279	80
74283	100
74284	440
74285	300
74286	90
74290	80
74293	80
74297	175
74298	160
74351	180
74365	70
74366	70
74367	70
74368	70
74376	120
74390	100
74393	100
74425	60
74426	60
74490	100

74C

74C244	150
74C245	150
74C373	180
64C374	425
74C922	550
74C923	600
74C925	650

74S

74S00	45
74S02	40
74S03	40
74S04	40
74S05	40
74S08	40
74S09	40
74S10	40
74S11	50
74S15	60
74S20	40
74S22	60
74S30	50
74S32	50
74S37	50
74S38	70
74S40	40
74S51	40
74S64	40
74S65	40
74S74	70
74S85	295
74S86	100
74S112	100
74S113	100
74S114	100
74S124	300
74S132	90
74S133	50
74S134	60
74S135	110
74S138	170
74S139	170
74S140	75
74S151	140
74S153	140
74S157	200
74S158	190
74S162	300
74S163	300
74S168	300
74S169	300
74S174	250
74S175	300
74S181	£11
74S182	250
74S188	180
74S189	225
74S194	280
74S195	320
74S196	395
74S197	300
74S201	250
74S225	500
74S226	350
74S240	375
74S241	375
74S244	475
74S251	225
74S257	225
74S258	225
74S260	70
74S262	£10
74S274	£10
74S275	£10
74S280	425
74S281	885
74S283	295
74S287	200
74S288	180
74S289	200
74S299	595
74S301	350
74S365	250
74S373	375
74S374	375
74S381	550
74S412	380
74S470	325
74S471	600
74S472	400
74S474	400
74S475	425
74S571	300
74S573	450

74LS

74LS00	25
74LS01	25
74LS02	25
74LS03	25
74LS04	25
74LS05	25
74LS08	25
74LS09	25
74LS10	25
74LS11	25
74LS12	25
74LS13	35
74LS14	50
74LS15	25
74LS20	25
74LS21	25
74LS22	25
74LS24	50
74LS26	25
74LS27	25
74LS28	25
74LS30	25
74LS32	25
74LS33	25
74LS37	25
74LS38	25
74LS40	25
74LS42	50
74LS47	80
74LS48	90
74LS49	100
74LS51	25
74LS54	25
74LS55	25
74LS63	55
74LS73	30
74LS74	35
74LS75	45
74LS76	40
74LS78	40
74LS83	70
74LS85	70
74LS86	35
74LS90	50
74LS91	90
74LS92	55
74LS93	55
74LS95	70
74LS96	90
74LS107	40
74LS109	45
74LS112	45
74LS113	40
74LS114	40
74LS122	70
74LS123	80
74LS124	125
74LS125	50
74LS126	50
74LS132	60
74LS133	50
74LS136	45
74LS138	60
74LS139	60
74LS145	95
74LS147	165
74LS148	130
74LS151	70
74LS153	70
74LS154	155
74LS155	70
74LS156	70
74LS157	60
74LS158	60
74LS160	70
74LS161	70
74LS162	70
74LS163	70
74LS164	75
74LS165	110
74LS166	150
74LS168	140
74LS169	100
74LS170	140
74LS173	100
74LS174	75
74LS175	70
74LS181	190
74LS183	190
74LS190	85
74LS191	85
74LS192	80
74LS193	80
74LS194	75
74LS195	75
74LS196	85
74LS197	85
74LS221	85
74LS240	80
74LS241	80
74LS242	95
74LS243	95
74LS244	80
74LS245	100
74LS247	105
74LS248	105
74LS249	105
74LS251	75
74LS253	75
74LS256	90
74LS257	75
74LS258	75
74LS259	125
74LS260	70
74LS261	100
74LS266	60
74LS273	120
74LS275	350
74LS279	70
74LS280	180
74LS283	80
74LS290	80
74LS293	80
74LS295	140
74LS297	850
74LS298	100
74LS299	225
74LS320	210
74LS323	400
74LS324	150
74LS347	120
74LS348	140
74LS352	110
74LS353	110
74LS356	200
74LS363	150
74LS364	150
74LS365	50
74LS366	50
74LS367	50
74LS368	50
74LS373	100
74LS374	100
74LS375	70
74LS377	130
74LS378	95
74LS379	130
74LS384	460
74LS385	330
74LS386	50
74LS390	60
74LS393	100
74LS395	110
74LS398	195
74LS399	135
74LS447	80
74LS465	140
74LS490	150
74LS540	100
74LS541	100
74LS624	155
74LS629	130
74LS640	200
74LS641	150
74LS645	195
74LS668	90
74LS669	90
74LS670	170
74LS673	890
74LS674	800
74LS682	250
74LS684	350
74LS687	350

SWITCHES

Toggle: 2 A, 250 V

SPST	35p
DPDT	48p

SUB-MIN-TOGGLE

SPST on/off	58p
SPDT c/over	64p
SPDT centre off	85p
SPDT biased both ways	105p
DPDT 6 tags	80p
DPDT centre off	88p
DPDT biased both ways	145p
DPDT 3 positions' on/on/on	185p
4-pole 2 way	220p

SLIDE 250 V:

DPDT 1 A	14p
DPDT 1 A c/off	15p
DPDT ½ A	13p

PUSHBUTTON
A
with 10 mm Button

SPDT latching	150p
DPDT latching	200p
DPDT moment	200p

Mini Non Locking

Push to Make	15p
Push to Break	25p

DIGITAST SWITCHES
Assorted colours
75p each

DIL SWITCHES

(SPST) 4 way **65p** 6 way **80p**
8 way **85p** 10 way **100p**
(SPDT) 4 way **190p**

ROTARY SWITCHES

(Adjustable Stop type)
1 pole/2 to 12 way; 2p/2 to 6 way:
3 pole/2 to 4 way; 4p/2 to 3 way **48p**

ROTARY: Mains: DP 250 V
4 Amp on/off **68p**

ROTARY: (Mak-a-Switch)
Make a multiway switch. Shafting assembly has adjustable stop. Accommodates up to 6 wafers (max. 6 pole/12 way + DP switch).
Mechanism only **90p**

WAFERS: (make before break)
to fit the above switch mechanism.
1 pole/12 way; 2 pole/6 way;
3 pole/4 way; 4 pole/3 way;
6-/2 way **65p**
Mains DP 4A Switch to fit **45p**
Spacers **4p**. Screen **8p**

ROCKER SWITCHES

ROCKER: 5A/250V SPST	28p
ROCKER: 10A/250V SPDT	38p
ROCKER: 10A/250V DPDT c/off	95p
ROCKER: 10A/250V DPST with neon	85p

THUMBWHEEL SWITCH
Mini front mounting

Decade Switch Module	275p
B.C.D. Switch Module	298p
Mounting Cheeks (per pair)	75p

VEROBOARD 0.1 in

	clad	plain
2½ × 3¼	95p	—
2½ × 5"	110p	—
3¾ × 3¾	110p	—
3¾ × 5"	125p	—
3¾ × 17"	420p	198p
4¾ × 17"	590p	275p
Pkt. of 100 pins		55p
Spot face cutter		150p
Pin insertion tool		185p

VQ Board	195p
DIP Board	395p
Vero Strip	95p

PROTO DECs

Veroblock	480p
S-Dec	360p
Eurobreadboard	590p
Bimboard 1	575p
Superstrip SS2	1360p

VERO WIRING

PEN + spool	380p
Spare spool	75p
Combs	6p

DALO ETCH RESIST PEN
Plus spare tip **100p**

FERRIC CHLORIDE
1 lb bag Anhydrous
195p + 50p P&P

ULTRASONIC TRANSDUCER
40 kHz 395p

COPPER CLAD BOARDS

Fibre glass	Single-sided	Double-sided
6" × 6"	100p	125p
6" × 12"	175p	225p

EDGE CONNECTORS

	.1"	.156"
2 × 6 way	—	75p
2 × 12 way	—	160p
2 × 15 way	—	165p
2 × 18 way	175p	160p
2 × 22 way	200	170p
2 × 23 way	150p	—
2 × 25 way	250p	245p
2 × 28 way	180p	—
2 × 30 way	280p	—
2 × 36 way	300p	—
2 × 40 way	320p	—
2 × 43 way	400p	—
2 × 75 way	600p	—

DIL SOCKETS

	Low Prof	Wire Wrap
8 pin	8p	25p
14 pin	10p	35p
16 pin	10p	42p
18 pin	16p	52p
20 pin	20p	60p
22 pin	22p	65p
24 pin	25p	70p
28 pin	28p	80p
40 pin	30p	99p

ANTEX SOLDERING IRON

C-15W	560p	CS17W	580p
G-18W	575p	XS25W	585p

Spare tips, assorted size	100p
Spare Elements	245p
Iron stand with sponge	195p

SIL SOCKET
0.1" pitch
20 way
65p

IDC CONNECTORS

PCB Plugs with latch	Pins Strt	Pins Angle	Female Header Plug	Female Card Edge Connect
10 way	90p	99p	85p	120p
16 way	130p	150p	110p	—
20 way	145p	166p	125p	195p
26 way	175p	200p	150p	240p
34 way	200p	236p	169p	320p
40 way	220p	250p	190p	340p
50 way	236p	270p	200p	350p
60 way	—	—	230p	495p

EURO CONNECTORS

	Female Strt. Pins	Socket Angle Pins	Male Strt Pins	Plug Angle Pins
DIN41617 31 way	125p	—	—	175p
DIN41612 2 × 32 A + B	200p	—	175p	220p
DIN41612 2 × 32 A + C	225p	—	185p	230p
DIN41612 3 × 32 A + B + C	280p	290p	295p	300p

DIL PLUG
(Header)

	Solder	IDC
14pin	40p	95p
16pin	45p	100p
24pin	85p	135p
28pin	150p	200p
40pin	200p	225p

RIBBON CABLE
price per foot

	Grey	Colour
10 way	15p	28p
16 way	25p	40p
20 way	30p	50p
24 way	40p	65p
28 way	55p	80p
34 way	60p	85p
40 way	70p	90p
50 way	85p	110p
64 way	100p	135p

ZIF TEXTOOL DIL SOCKETS

24 pin	575p
28 pin	695p
40 pin	845p

'D' CONNECTORS miniature

	9 way	15 way	25 way	37 way
MALE				
Solder lugs	55p	80p	120p	150p
Angle pins	110p	175p	225p	300p
PCB pins	100p	100p	160p	250p
FEMALE				
Solder lugs	90p	125p	180p	275p
Angle pins	150p	200p	260p	390p
PCB pins	100p	125p	195p	355p
COVERS				
IDC 25way 'D' Plug Socket	75p	70p	70p	85p

25way 'D' CONNECTOR RS232
Jumper Lead Cable Assembly

18" long, Single end, Male	495p
18" long, Single end, Female	525p
36" long, Double Ended, M/M	1025p
36" long, Double Ended, F/F	1050p
36" long, Double Ended, M/F	995p

PANEL METERS
FSD
60 × 46 × 35mm
0-50μA
0-100μA
0-500μA
0-1mA
0-5mA
0-10mA
0-50mA
0-100mA
0-500mA
0-1A
0-2A
0-25V
0-50V AC
0-300V AC
"S"
"VU"
465p each

CRYSTALS

32.768KHz	100
100KHz	400
200KHz	370
455KHz	370
1MHz	265
1.008M	275
1.28MHz	450
1.5MHz	525
1.6MHz	595
1.8MHz	545
1.8432M	220
2.0MHz	225
2.4576M	200
3.278M	150
3.5794M	96
3.6864M	300
4.0MHz	150
4.032MHz	290
4.194304M	200
4.433619M	100
4.80MHz	200
5.0MHz	150
5.185MHz	300
5.24288M	390
6.0MHz	140
6.1441MHz	140
6.5536MHz	225
7.0MHz	150
7.168MHz	175
7.68MHz	200
8.0MHz	150
8.08333M	395
8.86723M	175
9.00MHz	150
10.0MHz	175
10.24MHz	200
10.7	150
12.0MHz	150
12.528M	300
14.31814M	155
15.0MHz	200
16.0MHz	200
18.0MHz	150
18.432M	150
20.0MHz	150
19.968MHz	150
24.0MHz	150
24.930MHz	325
26.69M	150
27.648M	170
27.145M	190
38.66667M	175
48.0MHz	170
100.0MHz	295

RELAYS

Miniature, enclosed, PCB mount.
SINGLE POLE Changeover
RL6-91 205 Ω Coil; 12V DC (10V5 to 19.5 V). 10 A at 30 V DC or 250 V AC 185p
DOUBLE POLE Changeover. 6 A 30 V DC or 250 V AC
RL-113 53 Ω Coil, 6 V DC (5V4 to 9V9) 190p
RL6-111 205 Ω Coil, 12 V DC (10V7 to 19V5) 195p
RL6-114 740 Ω Coil, 24 V DC (22V to 37 V) 200p

ASTEC UHF MODULATORS
6 MHz Standard 375p
8 MHz Wideband 550p

BUZZERS, miniature, solid state
6V; 9V & 12V **70p**

PIEZO TRANSDUCERS
PB2720 **60p**

LOUDSPEAKERS
Miniature, 0.3W: 8Ω
2in, 3¼in, 2½in, 3in **80p**
2½in, 40Ω, 64Ω or 80Ω **80p**

MONITORS

- Zenith — 12" Green or amber, Hi-Resolution Popular **£66**
- MICROVITEC 1451, Med-Res, 14" Colour RGB input. Connecting Cable incl. **£237**
- KAGA 12". Med-Res. RGB. Colour. Has flicker-free characters. Ideal for BBC, Apple, VIC, etc. **£225** (car.7)
- KAGA 12". As above but Hi-Resolution **£310** (car.7)
- Connecting Lead for KAGA **£5**
- Carriage £7 securicor.

BBC MICRO WORD-PROCESSING PACKAGE

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4015	60
4016	40
4017	55
4018	60
4019	60
4020	80
4021	60
4022	70
4023	30
4024	50
4025	25
4026	90
4027	45
4028	45
4029	75
4030	35
4031	130
4032	65
4033	130
4034	140
4035	70
4036	250
4037	115
4038	110
4039	250
4040	60
4041	60
4042	50
4043	45
4044	50
4045	110
4046	60
4047	60
4048	55
4049	40
4050	35
4051	70
4052	60
4053	60
4054	85
4055	85
4056	85
4057	£10
4059	420
4060	70
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4085	60
4086	80
4089	125
4093	40
4094	70
4095	95
4096	100
4097	290
4098	80
4099	110
4160	95
4161	99
4162	99
4163	99
4174	99
4175	105
4194	105
4408	850
4409	850
4410	725
4411	750
4412	805
4415	590
4419	280
4422	770
4435	860
4440	999
4450	350
4451	350
4490	450
4500	675
4501	40
4502	60
4503	40
4504	100
4505	350
4506	100
4507	45
4508	130
4510	55
4511	55
4512	55
4513	150
4514	115
4515	115
4516	55
4517	275
4518	50
4519	35
4520	55
4521	115
4522	125
4526	70
4527	85
4528	70
4529	145
4530	90
4531	120
4532	65
4534	365
4536	250
4538	80
4539	80
4541	95
4543	70
4544	150
4548	40
4549	400
4553	245
4554	190
4555	35
4556	55
4557	250
4558	120
4559	396
4560	150
4561	104
4562	350
4566	160
4568	250
4569	175
4572	45
4580	255
4581	125
4582	99
4583	100
4584	55
4585	55
4597	330
4599	155
40085	90
40097	45
40098	42
40100	215
40101	130
40102	140
40103	412
40104	120
40105	220
40106	60
40107	55
40108	325
40109	80
40110	235
40114	240
40161	194
40163	75
40174	75
40175	75
40181	220
40182	90
40192	75
40193	70
40194	70
40195	75
40244	196
40245	196
40257	196
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45106	596

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(Securicor Carriage charge on printers is £7)

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- DFS Manual .... £7 (no VAT)

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(Securicor Carriage on Drives £7)

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new products

Correction — Farnell Electronic Components Ltd

Some of our readers may be disappointed to learn that we have been asked by Farnell Electronic Components to point out that their catalogue, announced in our June 1985 issue, is intended for our professional readers only.

Great little printer

Now available from STC Electronic Services is the Centronics GLP (Great Little Printer) Series dot matrix printer. Completely portable (3 kg), it measures just 333x191x70 mm, features a print speed of 50 c.p.s. (draft printing); near letter quality printing (12 c.p.s.); character pitch of 5, 8.5, 10, and 17 c.p.i.; horizontal tabulation; 48 international characters; high-resolution pin-addressable and IBM PC block graphics.

The GLP offers a choice of enlarged, condensed, emphasized, and double-strike print modes, as well as subscript, superscript, and underlining facilities. In addition, two copies besides the original may be obtained.

To interface the printer with a wide range of commonly used PCs simply requires a connecting cable to a Centronics parallel interface or a single unit incorporating the parallel interface plus the RS232.

The GLP's low cost, ease of operation, size and compatibility make it an ideal choice for the personal computer user.

STC Electronic Service
Edinburgh Way
Harlow
Essex CM20 2DE
Telephone:(0279) 26811 (3280/1)

Miniature fluorescent lamps

A new range of miniature fluorescent tubes has been introduced by Hero Electronics Limited. The sizes of the tubes range from 65 mm to 212 mm; available colours are red, yellow, green, blue, white, ultra-violet, and black. Black light tubes have uses in forgery detection to verify the correct ink on passports, credit cards, and currency.

The tubes can be run direct from the mains without choke starter or ballast, but with the appropriate dropping resistors. Life of the tubes is rated at 20 000 hours.

Hero Electronics Limited
Dunstable Street
Ampthill
Bedfordshire MK45 2JS
Telephone: (0525) 405015
Telex: 825906 (3297/3F)

DIY keyboards

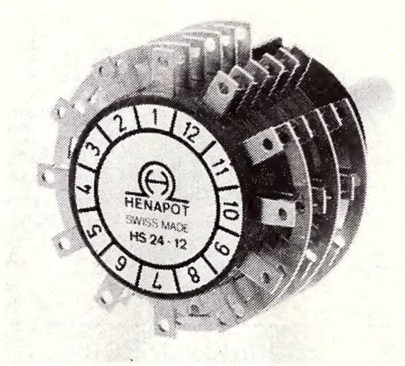
A do-it-yourself prototype keyboard kit that contains all the parts necessary to build a membrane switch/keyboard panel has been introduced by Swissinco. Available in 4, 12, 16, 40, 80, and 102-key versions, the kit includes the basic switch unit, overlay, colour pad, edge panel, and connector. Optional transfer lettering is available to add numbers, letters, or function words, depending on the user's application.

Swissinco UK Limited
Unit 2
225 Hook Rise South
Surbiton
Surrey KT9 7LD
Telephone: (01) 397 7041
Telex: 928574 (3297/8)

New rotary step switch

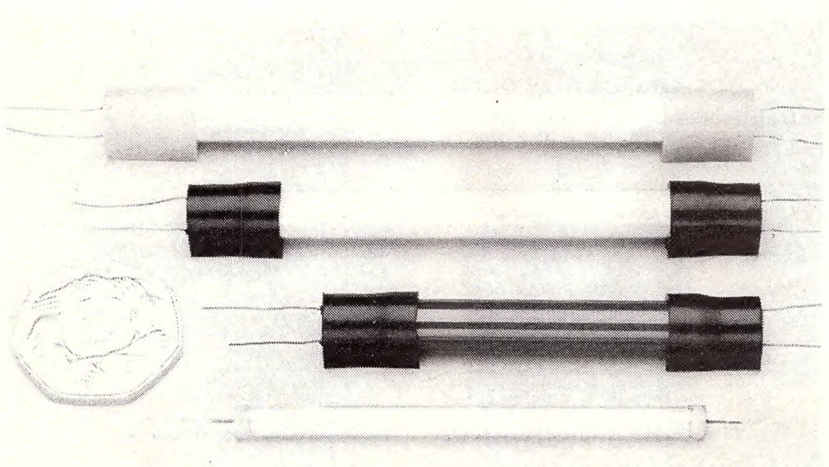
A new range of versatile rotary miniature step switches, manufactured by Henapot of Switzerland, is now available from Stanler Components.

The HS 24-12 range allows users to choose up to 12 switching positions and segments: all have a make or break switching option.



Various output pin arrangements are available. Maximum switching voltage is 250 V AC or 150 V DC, and the maximum switching current is 0.5 A AC or DC.

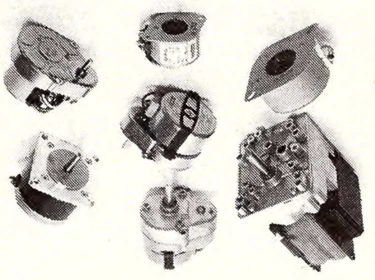
Stanler Components Limited
Business Centre
Hay Lane
Braintree
Essex CM7 6ST
Telephone: (0376) 40902 (3280/7F)



Hybrid and stepper motors

Crouzet's new range of hybrid and permanent stepper motors which includes twenty-one types plus controllers in the hybrid servo stepper motor range and five types plus controllers in the permanent magnet stepper motor range, offers significant advantages over many existing products.

Also available is an extensive range of multifunction electronic timers providing nineteen different functions, all with heavy-duty relay outputs, and single-function S-range solid-state output timers with adjustable timing intervals from 60 milliseconds to 10 hours. Each S-range timer is designed to operate at any voltage between 10 and 264 V.



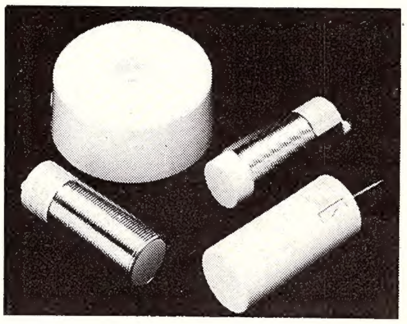
Crouzet Limited
108 Hawley Lane
Farnborough
Hants GU14 8HY
Telephone: (0252) 513211
Telex: 858612 (3280/4F)

Capacitive proximity sensors

Following the recent introduction of inductive proximity sensors and photoelectric devices, Sigma has now added a new range of capacitive proximity sensors to its already extensive switch and sensor range.

The new capacitive range contains both DC and AC models which will sense most materials including liquids.

DC models are tubular with either plain all-plastic bodies, or threaded metal-cased bodies. The shielded models have a sensing range of 15 mm, unshielded ones 20 mm. Outputs are p-n-p or n-p-n, normally open, with a maximum output current of 200 mA.



A similar range of sensors is available for AC input. The shielded and unshielded models have sensing ranges of 15 mm and 20 mm respectively, while a flat disc model offers an extended sensing range of 70 mm. AC sensors have NC or NO output at 5. . .200 mA.

Sigma Limited
Spring Road
Letchworth
Herts SG6 4AJ
Telephone: (04626) 3841
Telex: 825535 (3280/11F)

new products

Make your own PCBs

ALFAC have introduced a range of dry transfer products intended for use by professional designers of printed-circuit layouts as well as amateur hobbyists wishing to design and make their own PCBs.
Modern manufacturing techniques used by ALFAC and individual blister packing of each product ensure that the new range is of the highest quality. Complete accuracy is guaranteed to within specified close tolerances, which are essential to enable the designer to achieve the results demanded by today's high technology.
The new ALFAC Electronic catalogue, which is fully illustrated with scale drawings to assist selection of individual products, is available from ALFAC's distributor in the U.K.:

Pelltech Limited
FREE POST
Witney
Oxon OX8 6BR
Telephone: (0993) 72130/72014
Telex: 83147 (3297/1)

Desoldering tools

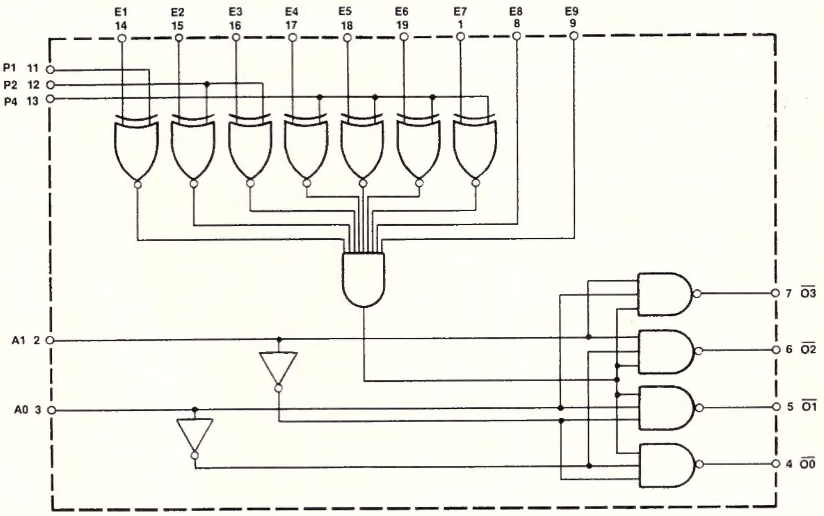
The Oryx range of soldering equipment has been updated by the re-design of four desoldering tools, together with the addition of a special anti-static version of the Oryx SR3A desoldering pump.

The re-designed tools, the SR Series, remove all unwanted solder from printed circuits and other soldered joints, and their unique design prevents molten solder from making contact with the actuator spring, a feature that provides for virtually maintenance-free operation. The SR3A has been developed to cater for most electronics applications. It has a safety guard, and action is triggered by simple push-button operation. Nozzles are 16 mm long and measure 2 mm diameter at the tip.

Greenwood Electronics Limited
Portman Road
Reading
Berkshire RG3 1NE
Telephone: (0734) 595844 (3297/5F)

µP programmable mapping decoder

A new low power ISO-CMOS programmable mapping decoder, the type MV74HCT515, designed for use in high speed memory and peripheral address decoding systems has been announced by Plessey. The device can also be used as a 9-bit pin programmable code detector.
The MV74HCT515 decodes two binary inputs, A_0 and A_1, to select one of four mutually exclusive, active low outputs (00 to 03), enabled by a pin-programmable 9-input AND gate, $E_1 \dots E_9$. Inputs E_8 and E_9 are permanently active high, while $E_1 \dots E_7$ may be programmed active high or active low in any combination by hard-wiring inputs P_1, P_2, and P_4.



MV74HCT515 logic diagram

Plessey Semiconductors Limited
Cheney Manor
Swindon SN2 2QW
Telephone: (0793) 36251
Telex: 449637 (3280/10F)

New concept in small power sources

Although sealed NiCd batteries offer an economic alternative to costly dry batteries, they have several shortcomings which often result in a premature fall-off in performance and early failure. Single NiCd cells have achieved 500...2000 charge/discharge cycles in well-documented tests, but when they are connected together to form a battery, the processes of reverse-charging, overcharging, dendrite formation, and electrolytic leakage in individual cells within the battery limit its useful life. Failure of just one cell in a packaged battery like the PP9 means scrapping the whole battery.
The use of a Verkon Type V9-a converter, operating from a single NiCd cell of size C, D, F, or super F, and providing a nominal 9 V DC output, obviates some of these shortcomings. It is intended as an alternative power source for dry batteries of the PP3, PP6, PP7, PP9, and their NiCd equivalent types, with performance benefits and cost savings.

J Biles Engineering
120 Castle Lane
Solihull
West Midlands B92 8RN
Telephone: (05432) 22382 (3297/4)

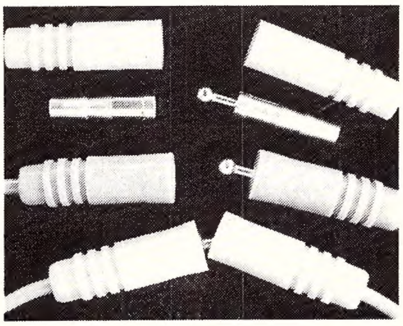
New photoresist

The Type ERP50 photoresist, the latest in a comprehensive range of chemicals — including cleaning, lubricating, and coating products — manufactured by Electrolube, is capable of producing high-quality printed circuits with a resolution of less than 0.1 mm.
For use with positive film makers, the ERP50 can be safely applied by whirler, spray, or dip coating to thicknesses of 2...8 µm.
Electrolube can provide a complementary range of products for the rest of the production cycle for printed-circuit boards, such as etching chemicals, particularly ferric chloride, and protective lacquers for use thereafter.
Electrolube's range also includes a comprehensive selection of repair and servicing aids for electronic circuitry: silver conductive paints for repairing PCB tracks, and Freezer for uses such as the detection of overheating components and the protection of circuit parts during soldering.

Electrolube Limited
Blakes Road
Wargrave
Berkshire RG10 8AW
Telephone: (073 522) 3014
Telex: 848797 (3297/2F)

Snaplox™ connectors

Oxley has extended its unique Snaplox™ connector range to cater for line-to-line connections. These connectors use a unique ball-and-socket design that ensures positive contact, and were originally developed for use in new generation military electronics and communications equipment; they are now widely used throughout the industry for testing and prototyping applications where quick and consistent connections are required.
The spherical design guarantees at least four points of contact and gives very low contact resistance and the minimum of electrical noise. The mated connection can move through a solid angle of 60°, beyond which it detaches itself without damage, but it has substantial resistance against detachment from in-line forces.



The line socket is compatible with PC mounted Snaplox™ connectors, and is available in a wide range of colours for circuit function identification.

Oxley Developments Co Ltd
Priory Park
Ulverston
Cumbria LA12 9QG
Telephone: (0229) 52621 (3297/6F)

readers' services

Printed-circuit boards, front panels, and software are obtainable from our London office.
Software may also be ordered from Technomatic Limited.

For all orders, please use the relevant order card provided opposite. Please allow 6/8 weeks for delivery.

Prices in sterling include 15 per cent value added tax, and should be increased by 55p (UK only) or £ 1.10 (other countries, except the USA) for postage and packing.

Prices in dollars are exclusive of any taxes, and include postage & packing for surface mail. If airmail is required, please add $ 1.50.

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Subscription rates for one year (11 issues: July/August is a double issue) are:

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airmail	$57.00
Other countries surface mail	£13.50
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TECHNICAL QUERIES SERVICE

Readers experiencing difficulties in the construction of projects published in *elektor electronics* within the last three years may write for advice to our London office. Please note that we can only answer letters that are accompanied by a stamped, self-addressed envelope or an International Reply Coupon. Owing to possible delays in our contact with the relevant designer, it may, unfortunately, take 8 to 10 weeks before you receive our reply.

BACK NUMBER SERVICE

Only the back numbers listed below are currently available.
Price are as follows:

any one issue (except July/August)	£ 1.50
additional issues, each	£ 1.30
July/August (Summer Circuits)	£ 3.00

Prices include postage and packing. For overseas orders requiring airmail postage add £ 1.50 per issue (£ 2.00 for July/August).

1978: February; June.
1979: October; November.
1980: February; September; October; November; December.
1981: February; April; May; September.
1982: September; October; November.
1983: January; February; April; May; July/August; September; October; November; December.
1984: January; February; March; April; May; June; July/August; September; October; November; December.
1985: January; February; March; April; May; June; July/August

COPY SERVICE

Photocopies of articles can only be supplied from out-of-print back issues of *elektor electronics*. State details of the article required, and the month of publication of the back issue containing the article together with your name and address on the relevant order card opposite. Cost of any one article is £ 1.50 (incl. p&p). Cost of additional articles (ordered at the same time) is £ 1.30 (incl. p&p).

BOOK SERVICE

The following books are currently available: these may be ordered from certain electronics retailers or bookshops, or direct from our London office.

Digibook (with PCB)	£6.30
300 Circuits	£5.80
Formant (1) (incl. cassette)	£6.30
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Junior Computer (2)	£6.90
Junior Computer (3)	£6.90
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Prelude (E94...E96)	83022-F*	4.40	8.75
7-day timer/controller front panel including membrane switches	83041-F*	13.10	26.25
Maestro	83051-F	4.90	9.75
capacitance meter	84012-F	5.20	10.50
real-time analyser	84024-F	7.80	15.50
direct-coupled modem	84031-F	4.50	9.00
pulse generator	84037-F*	4.60	9.25
µP-controlled frequency meter	84097-F	10.50	21.00
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programmable timer	85047-F	14.90	22.25

SOFTWARE SERVICE

µP TV games on cassette	**No.**	**£**	**$**
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15 programs: invaders, fishing, maze adventure, memory, pontoon, nim, etc.	009	6.90	13.75
15 programs: aliens, flipper, helicopter, pilot, basketball, hangman etc.	010*	6.90	13.75
15 programs: snakes & ladders, snap, mazes, break-out, horse races, cosmic adventure, Omega landing etc.	011	6.90	13.75

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	No.	£	$
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dark room computer ext. 1 x 2716 EPROM	514-N	8.40	16.75
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talking dice 1 x 2716 EPROM	516	8.40	16.75
ELEKTERMINAL + elekterminal 1 x 2716 EPROM	517	8.40	16.75
morse program for the Junior Computer 1 x 2716 EPROM	518	8.40	16.75
telex program for the Junior Computer 1 x 2716 EPROM	519	8.40	16.75
ASCII keysoft 1 x 2716 EPROM	520	8.40	16.75
character generator and video routines for DOS Junior 1 x 2732 + 1 x 2716 EPROMS	521	18.90	37.75
character generator and video routines for extended Junior 1 x 2732 + 2 x 2716 EPROMS	522	27.30	54.50
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typewriter interface 2 × 2716 EPROM	530	16.80	33.50
µP-controlled frequency meter 1 × 2732 EPROM	531	10.50	21.00
X-Y plotter 1 × 2732 EPROM	532	10.50	21.00
programmable timer 1 × 2732 EPROM	535	10.50	21.00
GHz pre-scaler 1 × 2732 EPROM	536	10.50	21.00

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pH meter	85024	9.75	4.85
KITT scanner	85025	8.00	3.95
AXL amplifier	85027	14.25	7.10
APRIL 1985			
real-time clock	84094	13.50	6,70
first cuckoo in spring	85016	9.50	4.70
X-Y plotter	85020	25.00	12.50
light-powered radio	85042	6.00	3.00
revolution counter	85043	12.25	6.10
10 A power supply	85044	13.50	6.75
MAY 1985			
programmable timer	85047-1	7.10	14.25
	85047-2	7.10	14.25
glow plug modulator	85053	3.40	6.75
automonitor	85054	4.40	8.75
universal I/O bus	85058	10.10	20.25
digitizer	85063	4.10	8.25
JUNE 1985			
tone burst generator	85057	2.90	5.75
infra-red movement detector	85064	7.35	11.00
RAM used as EPROM	85065	2.80	4.25
autoservice timer	85072	8.90	13.25
JULY/AUGUST 1985			
jumbo displays	85413-1	12.40	24.75
	85413-2	4.90	9.75
	85413-3	3.70	7.50
audio tester	85423	3.55	7.00
hi-fi headphone amplifier	85431	3.35	6.75
lead-acid battery charger	85446	2.75	5.50
improved logic probe	85447	2.50	5.00
light barrier	85449	4.35	8.75
microphone pre-amplifier with mute switch — symm.	85450-1	3.05	6.00
— asymm.	85450-2	2.95	5.75
discomixer	85463	11.85	23.75
6502 tracer	85466	2.85	5.75
sound-level-indicator	85470-1	4.05	8.00
	85470-2	6.55	13.00
twin dimmer	85480	2.75	5.50
model railway monitor panel	85493	3.70	7.50
SEPTEMBER 1985			
RS232 interface	85073	3.95	6.00
solid-state relay	85081	2.15	3.25
intruder alarm	85089-1	8.25	12.50
	85089-2	2.45	3.75
frequency standard	85092	4.00	6.00

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OCTOBER 1978			
VHF/UHF modulator	9967*	2.10	4.25
DECEMBER 1978			
elekterminal	9966*	9.90	19.75
SEPTEMBER 1979			
parametric equalizer tone control section	9897-2*	2.20	4.50
NOVEMBER 1979			
busboard	80024	7.70	15.50
MAY 1980			
Junior computer			
main board	80089-1*	16.60	33.25
supply board	80089-3*	4.00	8.00
FEBRUARY 1981			
voiced/unvoiced detector			
detector board	81027-1*	3.60	7.25
switch board	81027-2*	4.30	8.50
JUNE 1981			
Junior Computer			
−12 V supply	81033-2*	1.90	3.75
adaptor board	81033-3*	1.70	3.50
SEPTEMBER 1981			
disco light controller	81155*	4.20	8.50
DFM + DVM	81156*	5.60	11.25
revolution counter	81171*	6.40	12.50
NOVEMBER 1981			
power supply	9968-5A	1.90	3.75
high boost	82029*	2.50	5.00
DECEMBER 1981			
70 cm transverter (Oct.)	80133	16.50	33.00
VHF/UHF converter board	9864	2.30	4.50
flashing light	82038*	2.10	4.25
JANUARY 1982			
electronic chimes	82046*	2.10	4.25
FEBRUARY 1982			
universal NiCad charger	82070	2.80	5.50
APRIL 1982			
dynamic RAM card	82017	10.00	20.00
100 W amplifier	82089-1*	3.40	6.75
mini EPROM card	82093*	2.20	4.50
MAY 1982			
6502 housekeeper			
main board	81170-1*	5.40	10.75
display board	81170-2*	4.00	8.00
Z80-A CPU card	82105	9.30	18.50
JUNE 1982			
car alarm	82091*	3.00	6.00
electronic fluorescent light starter	82138*	1.80	3.50
SUMMER CIRCUITS 1982			
light-sensitive switch	82528*	2.10	4.25
5 V power supply	82570	2.90	5.75
SEPTEMBER 1982			
darkroom computer part I			
keyboard	82141-1	4.90	9.75
keyboard interface	82141-2*	2.70	5.50
display	82141-3	3.00	6.00
three phase tester	82577	3.50	7.00
OCTOBER 1982			
darkroom computer part II			
light meter	82142-1	2.30	4.50
temperature meter	82142-2	2.10	4.25
process timer	82142-3	2.70	5.50
wave shifter for SSB:			
low frequency converter	82161-1	2.70	5.50
high frequency converter	82161-2	3.00	6.00
NOVEMBER 1982			
model train lighting	82157	5.40	10.75
DECEMBER 1982			
precision power supply	82178	5.30	10.50
triopodus electrus diclopus	82179	3.90	7.75
crescendo	82180	6.10	12.25
JANUARY 1983			
3 A computer power supply	83002	2.40	4.75
milli-ohmmeter	83006	2.50	5.00
crescendo d.c. protection and countdown	83008	4.00	8.00
FEBRUARY 1983			
Prelude			
headphone amplifier	83022-7*	5.40	10.75
power supply	83022-8*	4.90	9.75
connection board	83022-9*	7.80	15.50
main beam dimmer	83028	2.00	4.00
MARCH 1983			
64 k memory card	83014	7.80	15.50
Prelude			
bus board	83022-1*	15.20	30.50
line amplifier	83022-6*	6.30	12.50
audio trafic lights	83022-10*	2.80	5.50
digital luxmeter	83037	2.70	5.50
APRIL 1983			
programmable darkroom timer	82048	5.50	11.00
Prelude			
MC prepreamplifier	83022-2*	5.30	10.50
MM preamplifier	83022-3*	6.50	13.00
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7-day timer/controller	83041	5.70	11 50
MAY 1983			
Maestro	83051-1	2.70	5.50
Watt meter	83052*	3.80	7.50
morse converter	83054	3.30	6.50
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JUNE 1983			
RTTY decoder	83044*	3.50	7.00
Maestro (part 2)	83051-2	16.60	33.25
energy meter	83067	3.60	7.25
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JULY/AUGUST 1983			
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microphone amplifier	83552*	2.70	5.50
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Prelude buffer	83562*	2.30	4.50
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alarm extension			
transmitter board	83069-1	3.50	7.00
receiver board	83069-2	3.40	6.75
VDU card	83082	13.40	26.75
personal FM	83087	3.00	6.00
OCTOBER 1983			
basicode interface for the Junior Computer	83101-2	2.00	4.00
cosmetics for FSK signals	83106	3.60	7.25
simple anemometer			
memory board	83103-1*	4.80	9.50
measuring board	83103-2*	2.00	4.00
NOVEMBER 1983			
bus board	80024	7.70	15.50
electronic metronome	83107-1*	3.60	7.25
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CPU card	83108-1	9.20	18.50
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speed controller for model railway	83110	4.30	8.50
DECEMBER 1983			
64-way bus extender board	83102	10.60	21.25
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disco phaser	83120-1*	5.60	11.25
	83120-2*	3.50	7.00
symmetrical power supply	83121	4.80	9.50
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JANUARY 1984			
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digital cassette recorder	83134	5.50	11.00
wind direction indicator	84001	6.70	13.50
how accurate is your watch	84005-1	4.60	9.25
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FEBRUARY 1984			
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	84007-2	3.90	7.75
rev counter for diesels	84009	2.00	4.00
capacitance meter	84012-1	5.30	10.50
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video combiner	84018	2.70	5.50
MARCH 1984			
triac control board	84019	6.10	12.25
Elabyrinth	84023-1	5.00	10.00
	84023-2	4.40	8.75
real-time analyser	84024-1	5.05	10.00
	84024-2	4.30	8.50
UHF video modulator	84029	3.40	6.75
APRIL 1984			
intelligent EPROM eraser	84017	5.30	10.50
real-time analyser	84024-3	15.50	31.00
	84024-4	21.60	43.25
variable a.c. power supply	84035	2.90	5.75
pulse generator	84037-1*	6.40	12.75
	84037-2*	7.70	15.50
MAY 1984			
real-time analyser	84024 5	4 80	9.50
video display	84024-6	8.00	16.00
mini crescendo	84041	6.50	13.00
switching power supply	84049	4.00	8.00
JUNE 1984			
portable distress signal	84048	3.30	6.50
ZX extensions	84054	3.85	8.00
daisywheel typewriter printer interface	84055	5.15	10.50
echo sounder	81105 1*	5.00	10.00
	84062*	5.95	12.00
FM wireless microphone			
transmitter	84063	3.85	7.75
receiver	83087	3.00	6.00
JULY/AUGUST 1984			
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economical motor drive	84427	2.55	5.00
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VHF/AM air-band converter	84438	3.75	7.50
RS 232 analyser	84452	3.45	7.00
musical doorbell	84457	3.05	6.00
frequency meter	84462	5.50	11.00
μP power supply	84477	5.95	12.00
SEPTEMBER 1984			
electronic cross over filter	84071	5.95	12.00
SCART adapter	84072	3.55	7.00
lamp saver	84073	2.55	5.00
	84083	2.40	4.75
digital tachometer	84079-1	3.40	7.00
	84079 2	4.60	9.25
flash counter	84081	4 35	8.75
direct-coupled modem design	84031	17.85	35.75
ZX81 pulse cleaner	84075	4.50	9.00
RS232 centronix adapter	84078	6.60	12.25
video inverter	84084	4.05	8.00
OCTOBER 1984			
direct-coupled modem design	84031	17.85	35.75
ZX81 pulse cleaner	84075	4.50	9.00
RS232 centronix adapter	84078	6.60	12.25
video inverter	84084	4.05	8 0
dynamic pre-amplifier	84089	2.85	5.75
NOVEMBER 1984			
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autodim	84096	2.65	5.25
telephase	84100	2.50	5 00
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JANUARY 1985			
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display board	85014	4.70	9.50
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FEBRUARY 1985			
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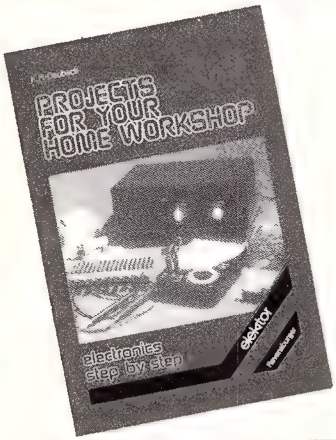

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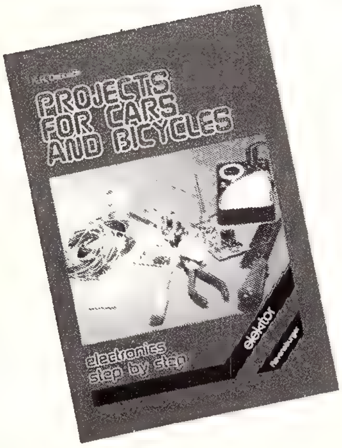

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Sooner or later most railway modellers are confronted with the problem that their model railway has become so extensive that it can no longer be controlled with two hands. The solution to this problem is automation, partially or completely. And nowadays that means using electronics! This book will guide the reader step by step through the intricacies of electronic controls. First, it deals with a power controller, then with the control of turnouts, next with a block protection system, and finally you are shown how to control your entire model railway with a computer. By building all the necessary elements yourself, costs can be kept at a reasonable level. Each stage of construction is complete within itself so that you can stop at the level of automation reached in that stage.

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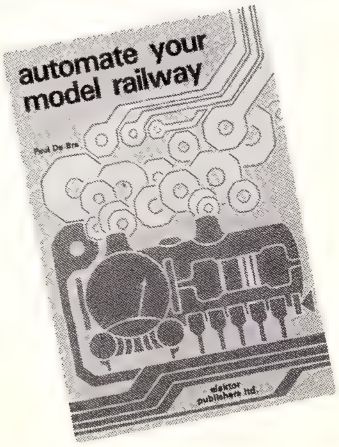

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150nF	15p

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150n	13p
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270n	16p
330n	22p
390n	24p
470n, 560n	27p
680n	33p
1µF (10mm)	37p
2 2µF (15mm)	75p

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10n to 100n	8p
150n	10p
220n	11p
330n	15p
470n	16p
680n	19p
1µF	25p
1 5µF	43p
2.2µF	45p

TANT BEADS

1/35V	14p
.22/35V	14p
.33/35V	14p
47/35V	14p
68/35V	14p
1/35V	14p
1 5/35V	14p
2 2/35V	15p
3 3/35V	18p
4 7 35V	14p
6 8/35V	23p
10/16V	21p
10/35V	31p
15/16V	25p
15/35V	41p
22/6.3V	29p
22/16V	32p

33 10V	34p
47 3V	32p
47 6.3V	35p
47 10V	78p
47 16V	99p
100/3V	35p
100 6 3V	1 28
100 10V	1.97
100 16V	2 75

ELECTRO-LYTICS Mainly Panasonic AXIALS (Wires each end)

µFd	V	
47	63	9p
47	100	10p
47	350	35p
1	100	10p
1	500	46p
2.2	25	9p
2.2	63	10p
2.2	100	13p
2.2	350	34p
3.3	40	13p
3.3	63	14p
4.7	35	10p
4 7	50	13p
4 7	63	14p
4 7	100	16p
10	25	9p
10	50	14p
10	63	16p
10	100	18p
10	350	55p
22	25	13p
22	40	16p
22	63	18p
22	100	24p
47	25	16p
47	40	20p
47	63	30p
47	100	32p
100	16	16p
100	25	18p
100	50	25p
100	63	29p
100	100	34p
220	10	18p
220	16	19p
220	25	25p
220	40	29p
220	63	34p
220	100	46p
470	16	25p
470	25	32p
470	40	38p
470	63	50p
470	100	69p
1000	16	34p
1000	25	43p
1000	40	53p
1000	63	75p
2200	16	53p
2200	25	71p
2200	50	80p
2200	63	1.54p
4700	16	87p
4700	25	99p

RADIALS (Wires one end)

µFd	V	
10	35	7p
22	10	7p
22	16	8p
47	10	8p
47	16	9p
100	10	10p
100	16	11p
220	10	13p
220	16	13p
470	10	14p
1000	10	23p
1000	16	28p
2200	10	39p
2200	16	51p
3300	10	57p
3300	16	75p
4700	10	75p
4700	16	1.09p
4700	63	2.99p
10000	16	2 99p
10000	80	4.95p

74TTL

7400	25p
7401	25p
7402	25p
7403	25p
7404	35p
7405	25p
7406	39p
7407	39p
7408	25p
7409	25p
7410	25p
7411	25p
7412	25p
7413	45p
7414	59p
7416	35p
7420	25p
7421	25p
7422	25p
7423	35p
7425	35p
7426	39p
7427	39p
7428	39p
7430	25p
7432	35p
7437	29p
7438	39p
7440	39p
7441	39p
7442	85p
7444	99p
7445	99p
7447	99p
7448	99p
7450	35p
7451	35p
7453	35p
7454	35p
7460	49p
7470	49p
7472	49p
7473	49p
7474	49p
7475	49p
7476	49p
7480	65p
7481	1.75
7482	95p
7483	95p
7484	95p
7485	95p
7486	39p
7489	1.99
7490	55p
7491	65p
7492	65p
7493	65p
7494	1.09
7495	55p
7496	55p
7497	1.99
74100	1 99
74104	49p
74107	15p
74109	69p
74110	1.99
74116	1.65
74118	99p
74119	1.79
74120	95p
74121	49p
74122	65p
74123	75p
74125	75p
74126	75p
74132	75p
74136	69p
74141	69p
74143	2.25
74144	2.25
74145	99p
74147	1 75
74148	1.29
74150	1.59
74151	65p
74154	1.39
74155	89p
74156	89p
74157	89p
74159	1.75
74160	1.05
74161	1 05
74162	99p
74163	99p
74164	99p
74165	1.05
74166	1.49
74170	1 79
74172	3 95
74173	1.45
74175	99p
74176	99p
74180	99p
74181	3.25
74182	1.35
74184	1.89
74185	1.89
74190	1.25
74192	99p
74193	99p
74194	99p
74195	79p
74196	1.19
74197	1.19
74198	2.25
74221	99p

74LS TTL

74LS00	24p
74LS01	24p
74LS02	24p
74LS03	24p
74LS04	24p
74LS05	24p
74LS08	24p
74LS09	24p
74LS10	24p
74LS11	24p
74LS12	24p
74LS13	32p
74LS14	49p
74LS20	24p
74LS21	24p
74LS22	24p
74LS27	24p
74LS28	24p
74LS30	24p
74LS32	24p
74LS33	24p
74LS37	24p
74LS38	24p
74LS40	24p
74LS42	49p
74LS47	85p
74LS51	24p
74LS54	24p
74LS55	24p
74LS73	29p
74LS74	35p
74LS75	45p
74LS76	35p
74LS78	35p
74LS83	69p
74LS85	75p
74LS86	35p
74LS90	49p
74LS92	55p
74LS93	55p
74LS95	75p
74LS107	39p
74LS109	45p
74LS112	45p
74LS113	45p
74LS114	45p
74LS122	69p
74LS123	85p
74LS124	1.35
74LS125	49p
74LS126	49p
74LS132	65p
74LS138	55p
74LS139	55p
74LS145	99p
74LS147	1.75
74LS148	1.35
74LS151	65p
74LS153	65p
74LS154	1.99
74LS157	55p
74LS158	69p
74LS160	75p
74LS161	75p
74LS162	75p
74LS163	75p
74LS164	75p
74LS165	1.09
74LS166	1.95
74LS169	99p
74LS170	1.65
74LS173	99p
74LS174	99p
74LS175	75p
74LS181	1.99
74LS183	1.99
74LS190	85p
74LS191	75p
74LS192	85p
74LS194	75p
74LS195	75p
74LS196	89p
74LS197	89p
74LS221	99p
74LS240	85p
74LS241	85p
74LS242	85p
74LS243	85p
74LS244	79p
74LS245	99p
74LS247	99p
74LS248	99p
74LS249	99p
74LS251	75p
74LS253	75p
74LS257	75p
74LS258	65p
74LS259	1.19
74LS261	1.19
74LS266	55p
74LS273	1.22
74LS275	3.49
74LS279	75p
74LS280	1.89
74LS283	79p
74LS290	79p
74LS293	79p
74LS295	1.35
74LS299	2.25
74LS323	3.09
74LS324	3.25
74LS325	1.65
74LS326	2.89
74LS327	2.89
74LS347	1.35
74LS348	1.95
74LS352	1.19
74LS353	1.19
74LS365	49p
74LS366	49p
74LS367	49p
74LS368	49p
74LS373	95p
74LS374	95p
74LS378	95p
74LS386	49p
74LS390	79p
74LS393	1.09
74LS395	99p
74LS396	2.95
74LS398	1.95
74LS399	1.49
74LS490	1.49
74LS540	1.39
74LS541	1.39
74LS640	1 95
74LS641	1,95

CMOS

4000	19p
4001	19p
4002	22p
4006	68p
~~4007~~	~~25p~~
4011	19p
4012	25p
4013	25p
4015	55p
4016	35p
4017	52p
4018	55p
4019	55p
4020	75p
4021	52p
4022	65p
4023	39p
4024	49p
4026	1.50
4027	39p
4028	47p
4029	75p
4030	35p
4031	1.25
4032	65p
4034	1.39
4035	95p
4036	2.75
4038	85p
4040	59p
4041	55p
4042	49p
4044	49p
4045	99p
4045	59p
4047	59p
4049	35p
4050	35p
4051	65p
4052	55p
4053	55p
4054	79p
4056	79p
4059	3 95
4060	65p
4063	85p
4066	39p
4067	2 25
4068	25p
4069	25p
4070	25p
4071	25p
4072	25p
4073	25p
4075	25p
4076	65p
4077	25p
4078	25p
4081	25p
4085	55p
4086	59p
4089	1.19
4093	35p
4094	69p
4095	89p
4096	89p
4098	79p
4099	99p
40103	1.95
4502	55p
4503	35p
4505	3.50
4507	35p
4508	1 19
4510	49p
4511	49p
4512	49p
4514	1 04
4515	1 05
4516	55p
4518	45p
4519	29p
4520	49p
4521	1 09
4522	79p
4526	65p
4527	65p
4528	65p
4529	1.25
4532	65p
4534	3 49
4536	2 49
4538	75p
4543	69p
4553	2 39
4555	35p
4556	49p
4560	1 45
4569	1.65
4584	55p
4585	59p

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2532 300N	3 49
2532-400N	3.45
2564	7.74
2708	2.99
2716	3.45
2732	4.35
2764 250	4.95
27128 250	6 14
4116 150N	1 25
4118	4 65
4164 150	3 96
6116	4 20
6810	1 55

MISC LOGIC

146818	4 50
ADC0804	5 85
ADC0816	20.80
ADC0817	12.54
SAA5000	4.05
SAA5010	7 81
SAA5012	7.81
SAA5020	5.95
SAA5030	6.99
SAA5040	15 95
SAA5041	15.95
SAA5050	8.95
SAA5070	18.95
8T26	1 09
8T28	1.09
8T95	1.09
8T97	1.09
81LS95	1 65
81LS97	1.65
81LS96	1 65
81LS98	1.65
6522	3 49
6522A	5.45
6532	5.25
6821	1 55
6840	3 75
6845	6 49
6847	6.49
8154	ASK
8155	3.30
8212	2 20
8216	1 60
8224	2 95
8226	2.95
8255	3.50
8271	53 00
Z80ACTC	2 99
Z80ADART	7 99
Z80APIO	3.19
ZN425E8	3 49
ZN426E8	7 99
ZN427E8	6 89
ZN428E8	4 55

V REGS

– Positive –
100mA TO92

78L05	29p
78L06	47p
78L08	47p
78L09	47p
78L12	29p
78L15	29p
78L18	47p
78L24	29p

1 Amp TO220

7805T	55p
7806T	85p
7808T	85p
7812T	55p
7815T	55p
7818T	85p
7824T	55p

1½ Amp TO3

7805K	2.33p
7808K	2.73p
7812K	2.33p
7815K	2.33p
7824K	2.33p

– Negative –
100mA TO92

79L05	49p
79L12	49p
79L15	49p

1 Amp TO220

7905T	66p
7906T	1.35p
7912T	66p
7915T	66p
7924T	66p

1½ Amp TO3

7905K	2.59p
7908K	2.70p
7912K	2.59p
7915K	2.59p
7918K	2 95p
7924K	2.95p

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18 pin	16p
20 pin	20p
24 pin	24p
28 pin	28p
40 pin	30p

TRANSISTORS

2N2219	42p
2N2219A	45p
2N2222	40p
2N2222A	42p
2N2369	34p
2N2369A	35p
2N2904A	44p
2N2905	44p
2N2905A	48p
2N3053	45p
2N3054	98p
2N3055	65p
2N3055H	1.84p
2N3439	1 44p
2N3440	99p
2N3441	1.55p
2N3442	2 05p
2N3553	2 95p
2N3632	19 95p
2N3702	16p
2N3703	16p
2N3704	16p
2N3705	16p
2N3706	16p
2N3707	16p
2N3819	35p
2N3820	69p
2N3866	1 20p
2N3903	13p
2N3904	16p
2N3905	17p
2N3906	15p
2N4036	1 04p
2N4037	1.06p
2N4240	2 78p
2N4400	21p
2N4401	27p
2N4402	26p
2N4427	1 34p
2N4871	75p
2N5296	93p
2N5298	98p
2N5401	45p
2N5415	1 67p
2N5416	1 97p
2N5447	36p
2N5448	36p
2N5449	36p
2N5450	63p
2N5451	66p
2N5457	63p
2N5458	57p
2N5459	63p
2N5460	63p
2N5551	26p
2N5657	2 25p
2N5684	15.10p
2N5686	14.50p
2N5884	4 60p
2N5886	4.60p
2N6027	60p
2N6030	9.70p
2N6031	10.90p
2N6058	3.58p
2N6059	3.86p
2N6123	1.54p
2N6126	1.72p
2N6212	2 96p
2N6254	2 90p
2N6387	1 95p
2N6676	11 45p
2SA496	99p
2SA509	72p
2SA678	77p
2SA684	45p
2SA699	1 02p
2SA706	4 99p
2SA771	3 60p
2SA1012	1 45p
2SB527	1 05p
2SB531	3 95p
2SB616	2 95p
2SB688	2 57p
2SC458	27p
2SC710	27p
2SC828	33p
2SC930	45p
2SC1061	85p
2SC1096	75p
2SC1213	29p
2SC1306	1 99p
2SC1307	299p
2SC1318	35p
2SC1909	1 95p
2SC1945	5 50p
2SC1947	6 88p
2SC1969	2 73p
2SC1970	2 37p
2SC2078	1 65p
2SD313	85p
2SJ49	4 95p
2SJ50	5 29p
2SJ82	4 30p
2SJ83	4 80p
2SK55	1.25p
2SK134	4.95p
2SK135	5.29p
2SK226	4 30p
2SK227	4 80p
3N201	1 10p
3SK88	95p
40250	1.95p
40361	75p
40362	75p
40363	3 99p
40406	1.75p
40408	1.75p
40410	1 99p
40411	4 29p
40594	1 40p
40595	1.40p
40673	1.49p
40822	1 99p
40871	1.15p
40872	1 15p
AC125	99p
AC126	35p
AC127	35p
AC128	39p
AC141K	39p
AC142K	39p
AC176	39p
AC176K	49p
AC187	39p
AC187K	49p
AC188	39p
AC188K	49p
AD161	55p
AD162	55p
BC107	16p
BC107A	17p
BC107B	19p
BC108	16p
BC108A	17p
BC108B	18p
BC108C	20p
BC109	17p
BC109B	18p
BC109C	21p
BC140	38p
BC141	43p
BC147	15p
BC148	15p
BC149	16p
BC157	39p
BC158	37p
BC159	44p
BC160	55p
BC161	59p
BC169	19p
BC169C	23p
BC177	29p
BC178	29p
BC179	31p
BC182	15p
BC182L	15p
BC183	14p
BC183L	15p
BC184	16p
BC212	16p
BC213	17p
BC213L	15p
BC214	18p
BC214L	19p
BC300	59p
BC301	59p
BC302	59p
BC303	59p
BC327	16p
BC394	52p
BC440	35p
BC441	37p
BC447	33p
BC448	33p
BC449	39p
BC460	38p
BC461	42p
BC477	37p
BC478	38p
BC479	38p
BC546	16p
BC547	19p
BC548	16p
BC549	17p
BC550C	19p
BC557	19p
BC559	18p
BC560C	19p
BC639	27p
BC640	27p
BC650	27p
BC651	27p
BCY70	31p
BCY71	33p
BCY72	25p
BD131	63p
BD132	63p
BD135	30p
BD136	30p
BD137	36p
BD138	36p
BD139	38p
BD140	38p
BD237	45p
BD238	45p
BD239A	63p
BD239C	66p
BD240A	68p
BD240C	79p
BD241A	66p
BD241C	68p
BD242A	69p
BD242C	79p
BD243A	76p
BD243C	81p
BD244A	76p
BD244C	84p
BD245A	1 26p
BD245C	1 30p
BD246A	1 30p
BD246C	1 46p
BD410	1 65p
BD419	1 45p
BD440	79p
BD441	99p
BD442	99p
BD529	1.10p
BD530	1 26p
BD535	82p
BD536	82p
BD537	85p
BD538	85p
BD651	99p
BD652	99p
BD677	89p
BD711	1.50p
BD712	1.50p
BDT62	99p
BDT63	98p
BDT64C	1 42p
BDT65C	1.37p
BDV64A	2.34p
BDV65A	2 34p
BDV65B	2 55p
BDV66B	2 65p
BDV93	1.05p
BDV94	1.05p
BDX32	3 90p
BDX33A	1 22p
BDX33C	1.26p
BDX34A	1.22p
BDX34C	1 26p
BDX42	78p
BDX43	83p
BDX45	85p
BDX66B	4 76p
BDX67B	4 76p
BDY56	3 23p
BF180	46p
BF198	18p
BF199	18p
BF200	79p
BF244A	83p
BF244B	83p
BF245A	63p
BF245B	60p
BF246	67p
BF246A	69p
BF246B	69p
BF256A	67p
BF256B	67p
BF256C	67p
BF257	67p
BF258	68p
BF259	69p
BF457	48p
BF458	59p
BF459	65p
BF900	1 33p
BF961	2 10p
BFR90	2 25p
BFR91	2 75p
BFS61	65p
BFS98	27p
BFT66	2 75p
BFX29	55p
BFX30	60p
BFY50	36p
BFY51	36p
BFY52	36p
BS170	65p
BSV81	2 65p
BSX20	33p
BSX21	49p
BU104	2 32p
BU105	1 89p
BU108	2 49p
BU109	1 99p
BU126	1 94p
BU204	2 49p
BU205	1 99p
BU206	2 16p
BU208	1 93p
BU226	4 45p
BU326S	2 75p
BU406	1 58p
BU407	1.58p
BU408	1.49p
BU409	1 69p
BU500	5 01p
BUX48	6 75p
E430	7 32p
J300	88p
J310	88p
MJ802	4 70p
MJ900	3.21p
MJ901	3 39p
MJ1000	1 78p
MJ1001	1 86p
MJ1800	3 79p
MJ2500	2.68p
MJ2501	3 08p
MJ2955	1.40p
MJ3000	2 42p
MJ3001	2 78p
MJ4502	5 90p
MJE340	75p
MJE350	1 20p
MJE2955	2 52p
MJE2955T	92p
MJE3055	2 42p
MJE3055T	89p
MPSA05	17p
MPSA06	17p
MPSA12	29p
MPSA13	25p
MPSA14	25p
MPSA20	49p
MPSA42	29p
MPSA43	29p
MPSA55	17p
MPSA56	17p
MPSA92	27p
MPSA93	27p
MPSL01	29p
MPSL51	29p
MPSU05	1 24p
MPSU06	1 34p
MPSU07	1 64p
MPSU55	1 42p
MPSU56	1 72p
MPSU57	1.86p
MRF450A	18 88p
TIP29A	35p
TIP29C	42p
TIP30A	37p
TIP30C	44p
TIP31A	56p
TIP31C	57p
TIP32A	58p
TIP32C	59p
TIP33A	1 22p
TIP33C	1 35p
TIP34A	1 27p
TIP34C	1 35p
TIP35A	1 87p
TIP35C	2.14p
TIP36A	1 94p
TIP36C	2 22p
TIP41A	47p
TIP41C	58p
TIP42A	62p
TIP42C	65p
TIP49	1.05p
TIP50	1 15p
TIP53	2 35p
TIP54	2 66p
TIP110	67p
TIP112	76p
TIP115	70p
TIP117	78p
TIP120	74p
TIP122	80p
TIP127	84p
TIP130	1 06p
TIP132	1 19p
TIP135	1.13p
TIP137	1.20p
TIP140	1 85p
TIP142	2.13p
TIP145	1 95p
TIP147	2 27p
TIP162	2 37p
TIP2955	95p
TIP3055	88p
TIS43	61p
VN10KM	69p
VN46AF	1 46p
VN66AF	1.65p
ZTX107	16p
ZTX108	15p
ZTX109	18p
ZTX300	16p
ZTX301	17p
ZTX302	18p
ZTX303	18p
ZTX304	20p
ZTX310	21p
ZTX312	23p
ZTX313	24p
ZTX314	27p
ZTX320	22p
ZTX330	26p
ZTX341	25p
ZTX450	22p
ZTX500	18p
ZTX501	19p
ZTX502	20p
ZTX503	21p
ZTX504	22p
ZTX510	22p
ZTX531	26p
ZTX650	36p
ZTX651	38p
ZTX652	42p
ZTX653	45p
ZTX750	37p
ZTX751	41p
ZTX752	45p
ZTX753	47p

DIODES

AA116	29p
AA119	30p
BA102	57p
BA155	20p
BA156	25p
BA157	25p
BA158	20p
BA159	21p
BA182	31p
BA317	4p
BAV10	10p
BAV20	13p
BAW49	21p
BAX13	8p
BAX16	8p
BY105	65p
BY109	45p
BY126	12p
BY127	13p
BY133	19p
BY399	27p
MR754 (400V 6A)	61p
MR756 (600V 6A)	87p
OA91	16p
OA200	10p
OA202	11p
IN914	4p
1N4001	4p
1N4002	4p
1N4004	5p
1N4007	7p
1N4148	3p
1N5401	13p
1N5404	16p
1N5408	20p
17A 200V	125p
17A 800V	158p
70A 400V	230p
70A 1 2KV	295p

SCR's TRIACS DIACS

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Suffix C = 300 V
Suffix D – 400 V
Suffix M – 600 V

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TIC106C	68p
TIC106D	69p
TIC106M	75p
8A	
TIC116A	88p
TIC116B	89p
TIC116C	93p
TIC116D	97p
TIC116M	99p
12A	
TIC126A	86p
TIC126B	90p
TIC126C	91p
TIC126D	92p
TIC126M	1 10p

TRIACS Texas 400V TO220 Case

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TIC225D (6A)	88p
TIC226D (8A)	89p
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TIC246D (16A)	1 40p
TIC253D (20A)	2 70p
TIC263D (25A)	2 91p

DIACS

BR100, DB3, ST2	29p

ZENER'S

E24 WIRE ENDED

400mW 3V3 to 33V	7p
1 3W 3V3 to 82V	14p
2 5W 7V5 to 75V	75p
5W 3V3 to 33V	80p

BRIDGE

(PIV shown in brackets)

1½ amp type

W01(100)	28p
W02(200)	34p
W04(400)	33p

2 amp type Square with hole

SO1(100)	46p
SO2(200)	50p
SO4(400)	55p

6 amp Square with hole

PW01(100)	95p
PW02(200)	99p
PW04(400)	1.30p
PW06(600)	1.39p

25 amp type Metal clad with hole

KO1(100)	2 62p
KO2(200)	2 75p
KO4(400)	3.25p
KO6(600)	4 10p
BYW64 35A 400W	3 68p

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G = Green
Y = Yellow

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G5D	16p
Y5D	16p

Small diffused

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G3D	16p
Y3D	16p

Micro 0.1"

RIM	21p
GIM	23p
YIM	23p

Large clear

R5C	14p
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Y5C	19p

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R5U	53p
G5U	53p
Y5U	53p

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CA3048	5 54p
CA3059	3 33p
CA3080E	69p
CA3130E	79p
CA3130T	2 22p
CA3140E	45p
CA3140T	1 67p
CA3240E	1 39p
HA1366W	1 99p
HA1388	3.96p
HA1389	2 96p
HA1389R	2 96p
HA1392	3.69p
HA1397	4.89p
ICL7106	7 51p
ICL7107	9 37p
ICL7611	85p
ICL8038	3.40p
ICM7555	69p
ICM7556	1 49p
L200C	1 99p
LA4201	1 99p
LA4400	1.99p
LA4420	1 36p
LA4422	1 93p
LA4430	1 94p
LA4440	2 98p
LA4460	2 98p
LA4461	2.98p
LF347	1 69p
LF351	39p
LF353	65p
LF355	1.15p
LF356	1.09p
LF357	1.63p
LF398	5 50p
LM10CH	6 99p
LM11CH	10 95p
LM301AN	36p
LM304H	4 34p
LM307N	74p
LM308N	69p
LM309K	2.09p
LM310N	3 33p
LM311N	69p
LM317K	3.57p
LM317T	1.45p
LM317HVK	10.80p
LM324	49p
LM334Z	1 39p
LM335Z	1 47p
LM336Z	1 30p
LM337K	6.58p
LM337T	1.36p
LM339N	45p
LM348N	84p
LM349N	1 73p
LM350K	5.99p
LM360N	6.24p
LM361N	3.63p
LM380N14	1 19p
LM380N8	1.39p
LM381AN	1.75p
LM382N	1 93p
LM383T	2 76p
LM384N	2.75p
LM386N	97p
LM387N	1.89p
LM388N	1 60p
LM391N60	1 55p
LM391N80	1 75p
LM396K	22 34p
LM723CH	1 25p
LM723CN	69p
LM725CN	5 93p
LM741CH	1 05p
LM741CN	28p
LM741CN14	1 20p
LM747CN	57p
LM748CN	62p
LM1035N	5 36p
LM1037N	3 62p
LM1458N	44p
LM1496N	1 67p
LM1886	5 58p
LM1889	2 99p
LM2902	1 22p
LM2907N	2 66p
LM2907N8	2 66p
LM2917N	2 66p
LM2917N8	2 66p
LM3301	1 16p
LM3524	2 95p
LM3900	69p
LM3911	2.09p
LM3914	2.99p
LM3915	2.99p
LM4250	2 89p
LM13600	1.64p
LM13700	1.64p
MC1466L	11.90p
MC1468L	8 50p
MC1488	99p
MC1489	99p
MC3340	2.66p
MC3357	2.11p
MC3446	3.95p
MC347	5 50p
MC3470	6.95p
MC4024	6 60p
MC4044	6 60p
MF10	4 18p
NE529	2 25p
NE531N	1 99p
NE543N	2 75p
NE544N	2 31p
NE555	28p
NE556	69p
NE558	1 89p
NE560	3 25p
NE565	1 06p
NE566	95p
NE567	1 95p
NE570	3 14p
NE571N	1 98p
NE5532AN	1 55p
NE5534A	1 49p
RC4194	2 60p
RC4195	2 06p
RC4558	63p
RC4739	1 08p
SN76477	7 95p
SN76003	3 50p
SN76013	3 50p
SN76023	3 50p
SN76033	3 50p
TA7204	1 19p
TA7205	1 15p
TA7222	1 75p
TA7227	2 85p
TBA500	3 99p
TBA510	3 25p
TBA520	2.99p
TBA530	2 99p
TBA540	3.25p
TBA550	3.25p
TBA560C	2 99p
TBA570	2 75p
TDA1002	4.35p
TDA1003	4.35p
TDA1010A	1 95p
TDA1011	2 50p
TDA1022	3 75p
TDA1024	1.12p
TDA1151	1 95p
TDA1170S	3 10p
TDA2002	1 95p
TDA2003	1 95p
TDA2004	2.48p
TDA2020	2 75p
TDA2030	1 99p
TDA2611	1.59p
TDA4600	2.79p
TDA7000	2.49p
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TL062	99p
TL064	1.25p
TL071	39p
TL072	56p
TL074	1 09p
TL081	39p
TL082	56p
TL084	99p
TL494	420p
TL497	2 69p
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UA759	3.77p
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UAA180	2.49p
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ULN2002	1 54p
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2 × 20V	8.95
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4 Thick bends
5 DIL pads
6 Transistor pads
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8 0 1" edge connectors
9 Mixture
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Scart skt.	58p

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DPDT	79p
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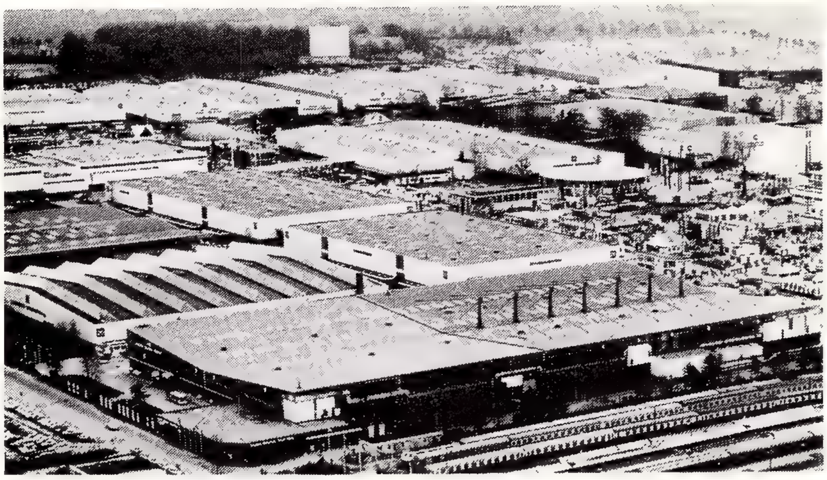
4PDT	3.79p

electronics scene



With more than 850 000 visitors from 120 countries, the 1985 Hannover Fair chalked up an absolute record in its 38-year history. For eight days, more than 7100 firms from 44 countries displayed highly innovative products and technologies. The world's largest industrial fair once more proved to be an effective marketing instrument capable of providing a strong business stimulus. The Hannover Fair has always served as a reliable economic indicator — and in 1985 there were clear signs of a positive trend in the entire economy.

Marconi hybrids for MoD

The Secure Systems Division of Marconi, Portsmouth, has been awarded a £2 million contract by the Ministry of Defence for the supply of a high-technology hybrid device for use within a range of modern communications equipment. The supply contract is the direct result of successful completion of the associated development contract.

The hybrid device is based on the use of silicon-on-sapphire — SOS — large scale integrated circuits — LSIs. This SOS LSI technology, originally developed for use within the SCIMITAR family of frequency-hopping secure combat net radios, has proved very successful in reducing the size, cost, and power consumption of the radios, and at the same time increasing greatly their capability and performance.

Maritime satellite communications to grow

The next ten years will see a big increase in the number of users of maritime satellite communications, according to the London-based International Maritime Satellite Organization (INMARSAT).

A threefold increase in the number of ships equipped with satcoms terminals is forecast for the next five years, and the number of terminals operational on board ships and offshore structures — currently about 3500 — is predicted to rise to 11 000 by 1990.

None of INMARSAT's forecasts includes the effect of the IMOS's Future Global Maritime Distress and Safety System carriage markets. Under the proposals for these rules, ships will either have to carry high-frequency digital radio equipment or a satellite communications terminal. Estimates suggest that up to 45 000 ships will need a new radio installation by the time FGMDSS is operational at the end of the 1980s, and, although there will be a choice in carriage requirements, INMARSAT hopes that most shipowners can be persuaded to fit satcoms equipment. (LPS)

A television graphics designer uses the Quantel Paintbox system to produce symbols for the BBC's weather forecasts. The equipment is installed in the BBC's computer graphics workshop in London. (LPS)

Apple in China

A recent agreement allows Apple Computer to sell personal computers and peripheral products to China through ACI Kaihin Limited, a company closely aligned with the Chinese government. Apple expects to begin shipment of its computer products this autumn.

Under the agreement, ACI Kaihin also becomes a certified software developer — a move designed to spur the development of Chinese applications software and the localization of existing software.

The agreement coincides with China's recent outline of a four-part high-technology strategy for the country's modernization. The strategy covers integrated circuit development, the use of main frame, mini, and micro computers, increased communication, and software development.

New aerial quadruples capacity

British Telecom International's latest satellite dish aerial at Goonhilly Downs earth station in Cornwall is one of the first in the world able to operate in four frequency bands.

The new dish, known as Goonhilly 6, is thirty-two metres in diameter and becomes fully operational later this year. It operates with British-designed radio transmission and reception equipment unmatched by similar systems currently in use around the world.

Goonhilly 6 is specially designed to work with a new transmission technology known as time division multiple access (TDMA) and digital speech interpolation (DSI). With TDMA, information is sent in separate bursts and each burst is allocated its own time slot on one frequency. With traditional methods, calls are separated from each other by using different frequencies.

DSI exploits the fact that, on average, during a telephone conversation each person is silent for about two thirds of the time. DSI uses a channel only when someone is actually speaking. At other times, the channel is free to carry bursts from other conversations.

Like other aerials at the earth station, Goonhilly 6 will handle ordinary telephone calls, telex, computer data, document facsimile transmissions, and television signals, as well as new, specialist services such as video conferencing. It will work to an Intelsat satellite over the Atlantic.

TDMA allows a number of dish aerials to send signals simultaneously to the same satellite. These signals need not be from aerials at the same location. For example, they could be sent from Goonhilly 6, and from an aerial at BTI's other satellite earth station at Madley in Hereford and Worcester.

British Telecom customers will benefit from improved international telecommunications capacity, plus better quality of transmission. International direct dialling from the UK is growing at around fifteen per cent a year. Last year nearly 400 million IDD calls were made to and from the UK, and in the same period UK-originated direct dial international telex transmissions exceeded 190 million. (LPS)

British Telecom International SatStream small-dish earth terminals will soon become a familiar sight on the rooftops of offices housing large and multinational companies. The system can transmit computer data, facsimile, electronic teleprinting, audio and video conferencing signals, as well as ordinary telephone speech. (LPS)

Simulator for Holland's Schreiner

Rediffusion Simulation of Crawley, West Sussex, is to supply an advanced technology flight simulator for the Fokker F-27 aircraft to the Dutch Schreiner Aviation Group under a £5 million contract.

The simulator will be installed at Europe's F-27 training facility at Beek, Limburg, in the southern Netherlands, and will be operational by early 1987. It will be used to supplement existing training programmes and will mean that Schreiner will be able to offer F-27 operators complete training packages.

Technically, the simulator incorporates state-of-the-art technology in all aspects of its design and manufacture, and includes a fully hydrostatic six-degrees-of-freedom motion system, microprocessor based control feel, and a MAGGS graphics based instructor station.

The host computer, a Gould Concept 32, will process a software programme developed by Rediffusion to represent the precise flight characteristics of the F-27 based on data provided by the aircraft manufacturer. (LPS)

electronics scene

Claudivs aid speech-impaired

Beattie Brooks lost her voice two years ago after a throat operation, but now a new machine is helping her to "talk" on the phone.

At the touch of a button, the new Claudivs Converse enables disabled people to select words and phrases which are transmitted by the built-in voice of the equipment developed by British Telecom.

Beattie, who lives in Littlehampton, Sussex, is one of the first people in the country to use Claudivs Converse; Claudivs stands for Calling Line Announcements Using Digitally Integrated Voice Synthesis.

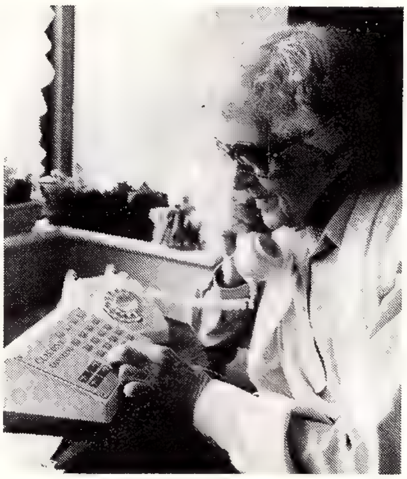
The unit, named after the Roman emperor who had a speech defect, can either be connected to a telephone line or used on its own to broadcast words, sentences, or messages through its loudspeaker.

It offers a combination of words giving access to a total of 64 possible phrases. In addition, there are four red emergency buttons to enable the user quickly to telephone the fire, police or ambulance services, automatically giving the caller's home address.

Phrases are recorded for the customer and then transferred digitally on to a speech synthesis microchip which is later installed into the unit. Male or female voices can be reproduced, in any language.

Despite her disability, Beattie is the local secretary for the RSPCA and has raised hundreds of pounds for them by making soft toys.

She has chosen many of the phrases with the help of her speech therapist and some aid her charity work.



Although she has no speaking voice, Beattie is a great communicator, "This machine is a bit of a miracle, it has given me a voice again", Beattie writes on the notepad she keeps beside her.

About 120 of the units are already being used by British Telecom customers. More are on the way, at a cost of about £250 each.

Will IBM succeed?

Everybody knows of IBM as the most successful computer company in the world, but relatively few observers know of the rather sad record IBM has amassed in telecommunications. One of the tools to gauge the company's strategic diversification into voice and data communications will be a new monthly newsletter, Telecom/IBM, published by International Resource Development Inc.

Rarely has a company been able to establish itself as a world leader in each of two different markets, and IBM has certainly had a rough ride in value-added networking, PBXs, and long-distance telephones. But now telecommunications is getting corporate-level attention, instead of being dealt with haphazardly and opportunistically by IBM's diverse divisions, a more purposeful strategy should emerge.

What IBM does not say, Telecom/IBM will. There is no connection between IBM and IRD: the newsletter will show complete objectivity of its coverage.

Hidden difficulties in SMAs

Revolutionary advantages are being proclaimed for surface mount techniques by the semiconductor vendors, but potential users are already experiencing unforeseen difficulties, warns *Surface Mounted Semiconductors*, a new study from Benn Electronics Publications (BEP).

Provisional research findings indicate that existing system designs are often poorly partitioned for surface mount realization, and this factor is delaying the introduction of such techniques by OEMs (original equipment manufacturers).

The problems stem from the current practice of including a mixture of control and associated higher dissipation interface circuits on PCBs. These higher power components are still unavailable in surface mount, leaving the designer with the choice of either using the unpopular mixed print board with a combination of through-hole and surface mounted devices, or repartitioning the design into surface mountable and through-hole boards.

Such repartitioning represents a major design investment, which is difficult to justify for an existing system and, therefore, tends to restrict the use of surface mount techniques to new systems.

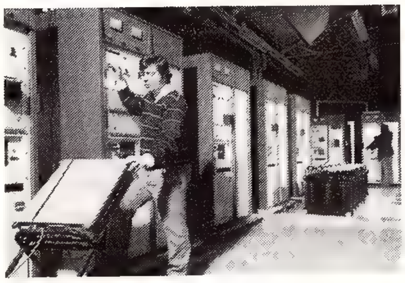
electronics scene

Mobile communications: a caution

From pagers to sophisticated equipment capable of high-speed data transmission, the mobile communications business is certainly not at a standstill. In this country, an estimated 500 000 pagers are in service, while forecasts of subscribers for the newly-launched cellular mobile radio system vary from 30 000 to 40 000 by the end of this year.
Little is said nowadays about the humble conventional mobile telephone and private mobile radio which started the whole business. None the less, they represent a substantial business, albeit overshadowed by the glamour of cellular radio with its better voice quality and potential for sophisticated data transmission.
West Germany is now developing the C-900 system of Siemens, which aims at 100 000 subscribers and is scheduled to start in May 1987.
France is developing Radiocom 2000, which is something of a hybrid system. An interesting characteristic of the French approach is that calls will be terminated after a specific time, which may be less than two minutes at peak hours. The French programme is due to start later this year and aims at 200 000 users by 1990.
In Scandinavia, the world's first mobile communications network — NMT (Nordic Mobile Telephone System) — recently signed up its 150 000th subscriber. This milestone is tinged with a certain amount of irony. The more subscribers, the more likely it is that the system will reach saturation at peak hours, leading to an unacceptable level of service: subscribers are not exactly overjoyed when as much as seventy per cent of calls fail to get through.
According to Bernard Herdan, Manager of the Communications and Systems Division of Mackintosh International, "it is undoubtedly a gross oversimplification to talk about a European market for mobile communications. While the CEPT (Conférence Européenne des Administrations des Postes et Télécommunications — European Conference of Post and Telecommunication Administrations) wants to develop a digital standard for cellular systems throughout Europe, individual country characteristics are ignored at the suppliers' peril. There is much to learn from the experience of Scandinavia, North America, and Japan: for instance, that forecasting demand for mobile communications equipment is full of pitfalls. The result is that, in the USA, most recent forecasts have proved over-optimistic, and in Scandinavia, pessimistic".
(Mackintosh International)

Double first for Logica

Logica is the first company in the information technology — IT — industry to be registered by the British Standards Institution — BSI — as a Registered Firm of Assessed Capability for the design, manufacture, and installation of electronic computer systems equipment.
To qualify for registration, Logica's Barnet factory had to satisfy the stringent detailed requirements of BS5750 Quality systems: Part 1 in conjunction with Quality Assessment Schedule QAS3302/40. This completes a unique double first for the company following its successful assessment only last year against Part 2 of the standard combined with QAS3302/44 Issue 1. BS5750 is the national quality standard, which, together with associated Kitemark and other certification schemes, is a key element in the Government's current quality drive to improve the UK's economic performance and competitiveness with other nations.
Logica has won an international reputation for computer software and systems development and operates in Belgium, the Netherlands, Sweden, West Germany, and further afield in North America, Australia, and Hong Kong. It also produces a wide range of advanced and specialized hardware for important UK customers, such as Reuters and Standard Telegraph and Cable.



Marconi Communication System Limited of Chelmsford has received an order from the BBC for a further twenty-eight Type B6526 VHF FM stereo amplifiers which are seen here undergoing testing. Eight of the amplifiers will be installed at Wenvoe (Cardiff), six at Blackhill (Glasgow-Edinburgh), six at Tacolneston (Norwich), and eight at Sandale (Carlisle). Installation of all twenty-eight will be completed within two years. The BBC already has six of these amplifiers which have been in service at Wrotham since 1982 carrying BBC Radio 1 and 2, Radio 3, and Radio 4 services.

Photograph by courtesy of The Marconi Company Limited.

Crow in Kuwait

Crow of Reading Limited has been awarded a contract worth over half a million pounds for the supply and installation of a supervisory desk system for the Kuwait Broadcasting Services.
The system will provide facilities for detailed monitoring of the quality of video and audio signals at baseband frequency and for monitoring the modulated RF signals. Measurements on a wide range of parameters can be made on any signal without interruption to the broadcasting service.

Security plus!

Full multiple level data security for wide and local networks and distributed systems has come a step nearer with a British initiative. GEC Computers Limited and TSL Communications Limited have been awarded contracts by the Ministry of Defence to produce Europe's first communications processors that will securely support multiple compartments of classified data traffic.
Known as SCP-2, the secure communications processor will solve the practical problems now faced by designers of secure data communications networks.
The contracts follow a two-year design and prototype development by TSL, part of which involved evaluating twenty mini and micro architectures. The GEC 4100 range was selected for its powerful systems protection architecture.
GEC Computers will undertake the implementation of SCP-2 at their Borehamwood centre. TSL Communications will act as the design authority concentrating on the security relevant aspects, including formal specification, security testing, and evaluation.
The equipment embodies not only all current needs for cross connecting at customer data rates, but also all expected needs for the growing market for sophisticated networks that Telecom Administration customers are now demanding.

National suffers, too!

National Semiconductor Corporation is reducing its workforce in the US and Europe by some 1300 employees, about 600 of whom at the company's headquarters in Santa Clara. The company also announced cancellation of a proposed semiconductor wafer manufacturing facility near Portland, Oregon. The moves reflect a recognition by the corporation that market conditions for semiconductors have not shown significant improvement since the downturn began a year ago.

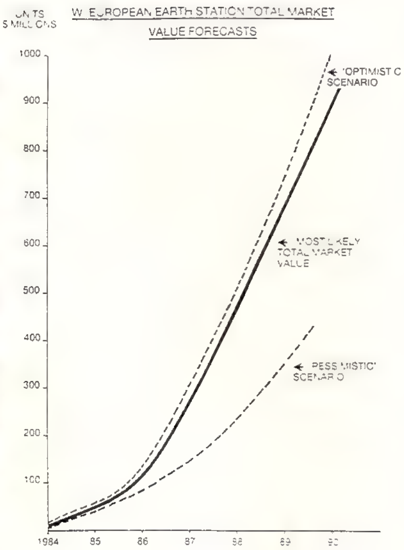
electronics scene

The Cellnet Radio Telephone System divides the country into a network of cells, each served by a single aerial. With cellular radio telephones (known as cellphones), users will be able to keep in touch from their cars — or even when walking down the street using a hand-held portable version that can be carried in a briefcase. They can be used like any other telephone, giving direct calling to or from anywhere in the UK or the rest of the world. British Telecom's Mobile Phone Division won the contract to install Cellnet's network of aerials and base stations. Seen in the photograph, Mr Rick Boran, an engineer from the Mobile Phone Division, is fitting a Cellnet aerial to the IBA transmitter tower at Beulah Hill, London.

Growing European market for satellite earth stations

Satellite service development has to date been relatively slow in Europe. However, there is now every expectation that growth trends in North America will be mirrored in Europe, creating a major new market for small earth stations.

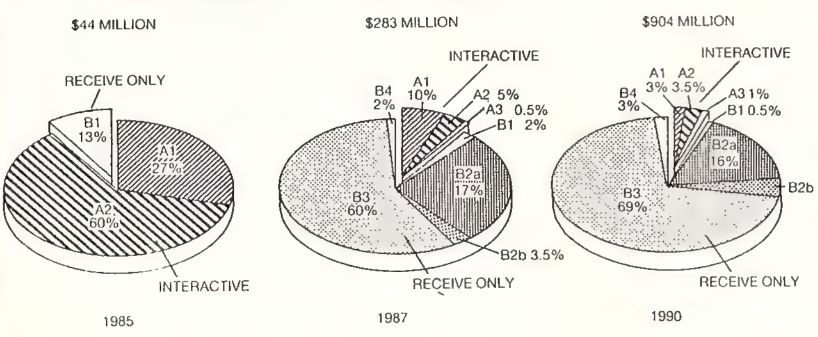
The findings of a major research programme on this subject are published in a four volume report produced by Mackintosh International.



The Mackintosh report shows that by 1990 there will be up to 375 transponders in orbit for European telecommunications fixed services. In addition, there will be up to 30 transponders for TV direct broadcast. Over the next five years around £3 billion will be invested in the development, launching, operation, and maintenance of the relevant satellites.

Overall, the annual western European market for small earth stations is forecast to grow to over £700M by 1990 from under £35 million today. This rapid growth will be accompanied by a dramatic shift in demand between different market sectors. While the demand for earth stations for satellite business services and cable TV networks will continue to grow steadily, the major growth areas will be for data microterminals, satellite master antenna TV (SMATV), community installations, and direct broadcast (DBS) home receivers.

The market development will, however, remain particularly vulnerable to government decisions, tariffication policy, and the successful launch of European DBS services.



CATEGORY A TRANSMIT/RECEIVE:
A1 Major Network/User Stations
A2 Data/Voice/Video/TV Links
A3 Data Links

B RECEIVE ONLY STATIONS:
B1 TV Distribution - CATV
B2a TV Distribution - (S)MATV
B2b Non-DBS Home Terminals
B3 DBS Terminals
B4 Business Service Terminals

Factron expands European support

Factron has expanded support for European ATE customers by opening a new support centre in Eindhoven's World Trade Centre for Electronics. It complements existing Factron facilities in Paris, Munich, London, Manchester, and Bournemouth, and further extends Factron's ability to meet ATE needs of European electronics companies quickly efficiently with local resources.

Eindhoven, which is home to many major electronics companies, has been chosen as Factron's Benelux support centre because of its strategic location.

The new support centre will be run by Hans Oortman, who joins Factron from Klaasing Electronics, where he worked as an instrumentation sales engineer.

Events

Electronic Displays (Exhibition)
Frankfurt Exhibition Centre
Frankfurt
West Germany
2. . .4 October 1985

Internepcon 1985 (Exhibition)
Metropole Convention Centre
Brighton
8. . .10 October 1985

Data Communications for Micros (Seminar)
Apollo Hotel
Amsterdam
9. . .10 October 1985

Introduction to Data Communications (Seminar)
Park Lane Hotel
London
14. . .15 October 1985

D'Angleterre
Copenhagen
21. . .22 October 1985

Data Communications Network Components (Seminar)
Connaught Rooms
London
16. . .18 October 1985

D'Angleterre
Copenhagen
23. . .25 October 1985

REGULATORS

LM 317T Plastic TO220 variable .... **£ 1.00**
LM 317 Metal .... **£ 2.20**
7812 Metal 12v 1A .... **£ 1.00**
7805/12/15/24 plastic **50p**
7905/12/15/24 plastic **50p**
CA 3085 TO99 Variable regulator ... **£ 1.00**
LM 723 14 dil **50p**

EPROMS/MEMORIES

27128-300nS .... **£ 5.00**
2764-300NS FUJITSU .... **£ 3.00**
2764-300NS USED, WIPED & VERIFIED **£ 2.40**
2716 EX EQPT .... **£ 2.00**
2708 NEW .... **£ 2.50**
2732 EX EQPT ... **£ 2.50** NEW ... **£ 3.00**
2114 EX EQPT **60p** 4116 EX EQPT **70p**
4164-200nS ..... **£ 1.80** 100+ ..... **£ 1.20**
6264LP-15 8K DYNAMIC RAM ..... **£ 5.50**

POWER TRANSISTORS

TIP 141, 142, 147 .... ea. **£ 1.00**
TIP 112, 125, 42B .... 2/**£ 1.00**
TIP 35B .... **£ 1.30** TIP 35C .... **£ 1.50**
SE9302100V10ADarl.simTIP121 ... 2/**£ 1.00**
2N3055 Motorola .... **50 p** 5/**£2.00**
2N3055 Ex eqpt. tested .... 4/**£ 1.00**
Plastic 3055 or 2955 equiv. **50p** 100/**£30.00**
2N3773 NPN 25A 160V ... **£1.80** 10/**£16.00**

DISPLAYS

Futaba 4 digit clock fluorescent display 5-LT 16 .... **£ 1.50**
Futaba 8 digit calculator fluorescent display 9 CT-01-3L .... **£ 1.50**
LCD Clock display 0.7" digits ...... **£ 3.00**
Large LCD Clock display 1" digits .. **£ 3.00**
7 seg 0.3" display comm. cathode 2/**£ 1.00**

QUARTZ HALOGEN LAMPS

A1/216 24 v 150 w .... **£ 2.25**
H1 12 v 55 w (car spot) .... **£ 1.25**

MISCELLANEOUS

MIN FLAT RELAY 24V 2 pole c/o 30 × 20 × 12mm sim RS 348-649 **£ 1.50** 100+ **£ 1.00**
4×4 MEMBRANE KEYBOARD ..... **£ 1.50**
NEW BRITISH TELECOM plug+lead **£ 1.50**
10,000μF 100V SPRAGUE 36D .... **£ 4.00** (£ 1.50)
15,000μF 40V SPRAGUE 36D .... **£ 3.00** (£ 1.50)
1.25" Panel fuseholders .... 5/**£1.00**
STAINLESS STEEL HINGES 14.5" by 1" open .... each **£1.00** 10/**£7.00**
Mains transient Suppressors 245 V 3/**£ 1.00**
TOK KEY SWITCH 2 POLE 3 KEYS ideal for car/home alarms . **£ 3** 100/**£ 2.00**
12 v 1.2 w small wire ended lamps/ fit Audi/VW/TR7/Volvo/SAAB . 10/**£ 1.00**
Heat shrink sleeving pack .... **£ 1.00**
PTFE sleeving pack asstd. colours .. **£ 1.00**
250 mixed res. diodes, zeners ...... **£ 1.00**
Mixed electrolytic caps. .... 100/**£ 2.00**
Stereo cass. R/P head .... **£ 2.50**
Mono head .. **£ 1.00** Erase head .. **50p**
Thermal cut-out 50°, 77°C, 85°C, 120°C**80p**
Thermal fuse 121°C 240 v 15 A 5/**£ 1.00**
VERO pins fit 0.1" Vero .... 200/**£ 1.00**
TO220 Micas + bushes .... 10/**50p** 100/**£ 2.00**
TO3 Micas + bushes .... 20/**£ 1.00**
Relays 240 v AC coil PCB mounting
2 pole changeover .... **£ 1.00**
3 pole changeover .... **£ 1.00**
Fig. 8 mains cassette leads ...... 3/**£ 1.00**
KYNAR wire wrapping wire 2oz reel .... **£ 1.00**
PTFE min. screened cable .... 10 m/**£ 1.00**
Tokin mains rfi filter 250 v 15 A .... **£ 3.00**
Mercury tilt switch small .... **£ 1.00**
Min. rotary sw. 4p c/o 1/8" shaft .... 2/**£ 1.00**
Thorn 9000 TV audio o/p stage .. 2/**£ 1.00**
10M7 CERAMIC FILTER ... **50p** 100/**£ 20**
6m or 9m CERAMIC FILTER .... **50p** 100/**£ 25**
240 v AC FAN 4.6" SQUARE NEW .... **£ 5.50 (£ 1)**
240/115 v AC FAN 4.6" sq. NEW**£ 7.00 (£ 1)**
BELLING-LEE 12 way block L1469 .... 4/**£ 1.00**
POTENTIOMETERS short spindle
2k5 10k 2m5 1m lin 25k log ...... 5/**£ 1.00**
500k lin 500k log long spindle .... 4/**£ 1.00**
40 kHz ULTRASONIC TRANSDUCERS ex. eqpt. NO DATA .... pair **£ 1.00**
Stick-on cabinet feet .... 30/**£ 1.00**
TO3 transistor covers .... 10/**£ 1.00**
transistor mounting pads TO5/TO18 **£ 3**/1K
DIL Reed Relay 2 pole N/O contacts **£1.00**

RECTIFIERS

120 v 35 A stud **65p**
12FR400 12 A 400 v small stud ... 4/**£ 1.50**
BY 127 1200 v 1.2 A .... 10/**£ 1.00**
BY 254 800 v 3 A .... 8/**£ 1.00**
BY 255 1300 v 3 A .... 6/**£ 1.00**
1 A 800 v bridge rectifier .... 4/**£ 1.00**
6 A 100 v bridge **50p**
10 A 600 v bridge .... **£ 1.50**
15 A 100 v bridge .... **£ 1.50**
25 A 200 v bridge . ea. **£ 2.00** 10/**£ 18.00**
25 A 400 v bridge ..... **£ 2.50** 10/**£ 22.00**

SCRs

MCR72-6 400 v .... **£ 1.00**
BTX95 800 v 15 A .... **£ 1.50**
35 A 600 v stud .... **£ 2.00**
MCR106 equiv. 4 A 400 V **40p**
2N5061 800 mA 60 v TO92 ...... 4/**£ 1.00**
TICV 106D .8 A 400 v TO92 3/**£ 1** 100/**£ 15.00**
MEU21 Prog. unijunction .... 3/**£ 1.00**

TRIACS

diacs **25p**
TXAL225 8A 400V 5 mA gate .... 2/**£ 1** 100/**£ 35.00**
25A 400V ex eqpt. tested **£1.50**

CONNECTORS

(EX EQPT. price per pair)
'D' 9 way £ 1 15 way **£ 1.25** 25 way **£ 2**
37 way **£ 2** 50 way **£ 3.50** covers **50p ea.**
NEW 25way PCB skt .... **£ 1.00**
D9 PCB PLUG 90 deg. .... **£ 1.50**
0.1" d/sided edge connector, 32 way, ideal ZX81/SPECTRUM .... **£ 1.50**
0.1" d/sided pcb plug 24 + 25 way **£ 1.50**
2 pole sub min. connectors ideal radio control RS466/472/488/343 .... 5 pairs/**£ 2.00**

IDC CONNECTORS

25 way 'D' Plg/Skt 37 'D' PLUG ea. **£ 2.00**
20 way socket (BBC user port) ..... **£ 1.00**
26 way socket (BBC printer) .... **£ 1.50**
34 way socket (BBC disc drive) .... **£ 2.00**
40 way socket .... **£ 2.00**

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10 of one value for .... **£ 1.00**
1R0, 2R0, 2R7, 3R9, 5R0, 10R, 12R, 15R, 18R, 20R, 27R, 33R, 36R, 47R, 120R, 180R, 330R, 390R, 470R, 560R, 680R, 820R, 910R, 1K15, 1K2, 1K3, 1K5, 1K8, 2K4, 2K7, 3K3, 10K

W22 or sim. 6 watt
7 of one value for .... **£ 1.00**
R47, 1R5, 9R1, 10R, 12R, 20R, 33R, 51R, 56R, 62R, 120R, 180, 270R, 390R, 560R, 620R, 1K, 1K2, 2K2, 3K3, 3K9, 10K

W23 or sim. 9 watt
6 of one value for .... **£ 1.00**
R22, 1R0, 3R0, 6R8, 56R, 62R, 100R, 220R, 270R, 390R, 680R, 1K, 1K8, 10K

W24 or sim. 12 watt
4 of one value for .... **£ 1.00**
R50, 2R0, 10R, 18R, 47R, 68R, 75R, 82R, 150R, 180R, 200R, 270R, 400R, 620R, 820R, 1K.

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Slotted opto-switch OPCOA OPB815 .... **£ 1.30**
2N5777 .... **50p**
TIL81 TO18 Photo transistor .... **£ 1.00**
TIL38 Infra red LED .... 2/**50p** 100/**£ 25.00**
OPI2252 Opto isolator **50p**
Photo diode .... **50p** 6/**£ 2.00**
MEL12 (Photo darlington base n/c) .. **50p**
RPY58A LDR ...... **50p** ORP12 LDR **85p**
LEDs RED 3 mm or 5 mm ..... 12/**£ 1.00** 100/**£ 6.00**
GREEN + YELLOW 3 or 5 mm 10/**£ 1.00** 100/**£ 6.50**
FLASHING RED 5 mm .... **50p** 100/**£ 30**

DIODES

1N4148 .... 100/**£ 1.50**
IS3740 Germanium .... 100/**£ 2.00**
1N4004 or SD4 1 A 300 V ..... 100/**£ 3.00**
1N5401 3 A 100 V .... 10/**£ 1.00**
BA 157 1 A 400 V Fast recovery .... 100/**£ 2.50**
BA 159 1 A 1000 V Fast recovery .... 100/**£ 4.00**

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10R, 20R, 100R, 200R, 500R, 1K, ... **50p**
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8 pin .... 12/**£ 1.00**
14 pin .... 10/**£ 1.00**
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22/28 pin **25p**
24 pin .... **25p** 100/**£ 20.00** 1K/**£100.00**
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GREEN 2- 22 pF .... 5 for **50p**
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control voltage 8-28 V DC .... **£ 2.50**
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10n/15n/22n/33n/47n/68n 10 mm rad .... 100/**£ 3.00**
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1μ 250V C280 .... 5/**£ 1.00** 100/**£ 10.00**
1μ5 P/carb 15 mm rad ... 100/**£ 7.00 (£1)**
2μ2 160 V rad 22 mm . 100/**£ 10.00 (£1.50)**
470n 250 V AC X rated rad ... 4/**£ 1.00**
33n/47n 250 V AC X rated rad 15 mm 10/**£ 1.00**
10n 250 V AC X rated rad 10 mm10/**£ 1.00**
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GLASS BEAD NTC Res at 20'c **80p**
250R, 1K2, 50K, 220K, 1M4
R53 Thermistor **£2.00**

BEAD TANTALUM CAPS

47 μ 3 V, 68 μ 6 V .. 12/**£ 1.00** 100/**£ 6.00**
2μ2 20 V .... 8/**£ 1.00** 100/**£ 8.00**

MONOLITHIC CERAMIC CAPS.

100n 50V .... 100/**£ 5** 1k/**£ 35**
100n 15V AX SHORT LEADS .. 100/**£ 3.00**
10 n 50 V 100/**£3** 470 n 50 V .. 100/ .. **£ 7**
1μF 50 V .... 100/**£ 12**
10n 50V DIL package 0.3" rad. 100/**£4** 1k/**£30**

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ELECTRONIC COMPONENTS BOUGHT FOR CASH

8 New Circuitmate Multimeters

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From Beckman Industrial comes a new range of eight low-cost 3½ digit multimeters — the 'Circuitmate' series.

They include three pocket-size models with extras not found even in most large multimeters, two full-size handheld instruments for field or bench use, two autoranging models, including one of the smallest in the world, and an extra-compact, extra low-cost model with most of the features of the bigger meters.

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Tel: 021-742 7921 Telex: 336659

ELEKTOR BOOKS

RESI & TRANSI

A series of strip cartoons in book form in which two enterprising characters explore the field of electronics in their own inimitable way. Their adventures are full of tension, because they often go against the current — whereby they encounter much resistance — before they reach their goal. These books familiarize the reader with electronics in an unusual way: exciting, playful, yet thorough. Part I comes complete with a printed-circuit board and resimeter.

Part I: Banish the Mysteries of Electronics £6.10
Part II: Hands off my Bike! £4.80

TV GAMES COMPUTER

This book, provides a different — and, in many ways, easier — approach to microprocessors. The TV games computer is dedicated to one specific task, as the name suggests. This provides an almost unique opportunity to have fun while learning!

Price £7.10

DIGIBOOK

Provides a simple step-by-step introduction to the basic theory and application of digital electronics and gives clear explanations of the fundamentals of digital circuitry, backed up by experiments designed to reinforce this newly acquired knowledge. Supplied with an experimenter's PCB.

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300 CIRCUITS

For the home constructor — 300 projects ranging from the basic to the very sophisticated.

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DATA SHEET BOOK

Here at last is the book that designers have been waiting for: the Elektor Data Sheet Book. In 240 pages it gives you a CMOS, a Linear, Special Function and Audio Data *Book: extensive information on 269 of* the most important IC's. A very useful and economical reference book!

Price £8.40

JUNIOR COMPUTER BOOK 1

For anyone wishing to become familiar with (micro)computers, this book gives the opportunity to build and program a personal computer at a very reasonable cost.

Price £6.90

JUNIOR COMPUTER BOOK 2

Follows in a logical continuation of Book 1, and contains a detailed appraisal of the software. Three major programming tools, the monitor, an assembler and an editor, are discussed together with practical proposals for input and peripherals.

Price £6.90

JUNIOR COMPUTER BOOK 3

The next, transforming the basic, single-board Junior Computer into a complete personal computer system.

Price £6.90

JUNIOR COMPUTER BOOK 4

Book 4, the last in the series, describes all the software required to operate the complete system. A number of peripheral devices, such as a printer and a video terminal, may be 'hooked up' to the computer. During the final stage in its 'growth', the machine is able to extend its linguistic skills, for a special version of BASIC is now available on cassette.

Price £6.90

301 CIRCUITS

The book is a continuation of our popular and very successful 300 circuits publication. It is composed of 301 assorted circuits ranging from simple to more complex designs, described and explained in straightforward language.

Price £5.80

MICROPROCESSOR HARDWARE

This book describes a range of peripheral equipment that can be connected and used with an assortment of personal computers which use the 6502, 6809, Z80 or the 8080 CPU.

Price £7.90

JUNIOR COMPUTER VIA 6522

This book deals with the well-known Versatile Interface Adapter (VIA) type 6522. Although it is an indispensable addition to the four books already devoted to the Junior Computer, it is not aimed solely at Junior users, but at anybody who has a system with one or more 6522s. It affords a complete familiarization with this flexible and effective component.

Price £3.50

SC/MPUTER (1)

Describes how to build and operate your own microprocessor system — the first book of a series — further books will show how the system may be extended to meet various requirements.

Price £5.80

SC/MPUTER (2)

The second book in series. An updated version of the monitor program (Elbug II) is introduced together with a number of expansion possibilities. By adding the Elekterminal to the system described in Book 1 the microcomputer becomes even more versatile.

Price £5.80

FORMANT

Complete constructional details of the Elektor Formant Synthesiser — comes with a FREE cassette of sounds that the Formant is capable of producing together with advice on how to achieve them.

Price £6.30

33 ELECTRONIC GAMES

A selection of circuits which give as much enjoyment in building them as actually playing the games. The circuits are fascinating although the electronics involved are not complex and therefore anyone with a good soldering iron will find this book satisfying. These are electronic games that do not need a TV screen, and as a result can be played just about anywhere.

Price £4.80

JUNIOR PAPERWARE 1

Modifications of the PM/PME EPROM: Source listings, Hex dump of the Software cruncher and puncher (Elektor 85, May 1982)

Price £2.10

JUNIOR PAPERWARE 2

Source listing of the bootstrap loader for Ohio Scientific Floppys: Hex dump of the EPROM (ESS 515)

Price £2.10

PAPERWARE 3 & 4

The hardware for a Universal Terminal has already been described in Elektor. It consists basically of a VDU card and a CPU card, but, of course, to make the terminal work some software is also needed. Two new books are now available to meet this need. Paperware 3 not only includes all the necessary software, but also deals with all the 'ins' and 'outs' of the terminal. Paperware 4 provides all the software and other information for using the Universal Terminal with the Junior Computer, either in expanded form or with DOS.

Price: Paperware 3 . . . . £2.70
Paperware 4 . . . . £2.80

EXTENDED PRESET UNIT FOR THE POLYPHONIC SYNTHESIZER

This book is the culmination of a project which was started in the October 1981 issue of Elektor and to which since then no fewer than nine articles have been dedicated. It is no exaggeration to say that the polyphonic synthesizer can be used to its full potential only with the extended preset unit. The booklet is divided into five distinct sections: the construction and fitting of the various cards, a functional description, calibration and testing, fault-finding, and tracking of the voltage-controlled filter and low-frequency oscillator. It is possible to build and test all the circuits and then fit them all at once into the synthesizer or build and add them piecemeal. As the booklet is intended more as a reference work than a full instruction manual, the chapters can be read in any order. The booklet assumes reasonable familiarity with computer technology.

Price £1.60

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intruder alarm

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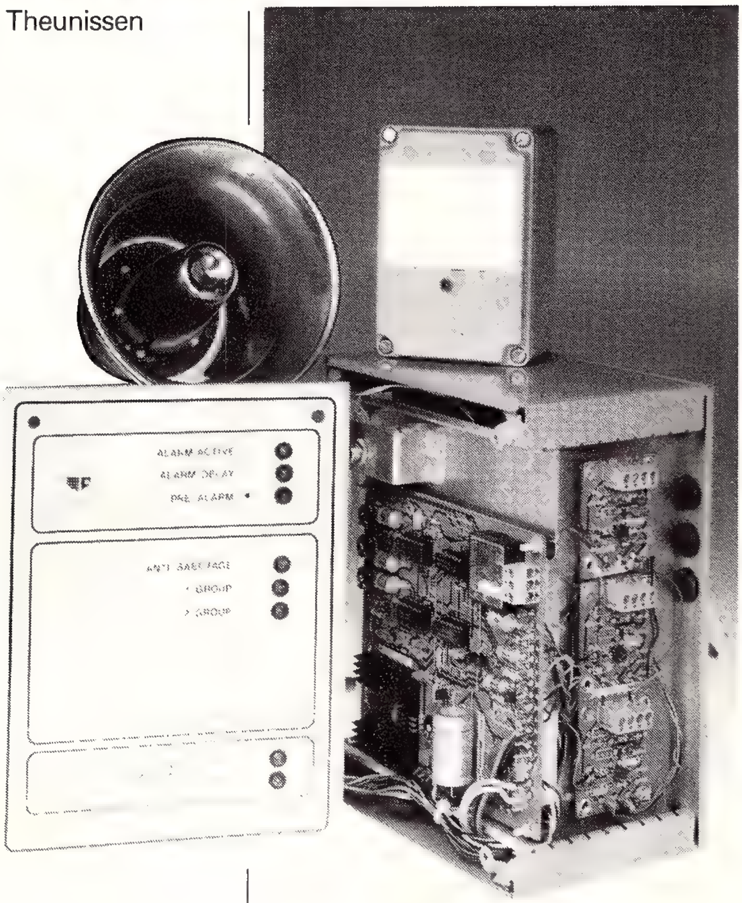

a combination of infra-red and electronics technologies

With burglaries on the increase in most parts of the world, there is a growing demand for good, reliable, yet inexpensive, security equipment. Manufacturers of burglar alarms are convinced that there are many millions of people prepared to spend money — in many instances a great deal — to protect their property. The intruder alarm described in this article is intended for use with a number of infra-red movement detectors featured in the June 1985 issue of *elektor electronics*, but can also work with other types of sensor.

The alarm uses a minimum of two printed circuits: one for the control circuits, and the other for the interfaces. The latter may be repeated a number of times if required. The interface board is designed to connect either two infra-red sensors or one infra-red sensor and an anti-tamper circuit to the control board. Other than infra-red sensors may also be used. To this end, each interface offers two operating conditions: (a) NO, in which the switching contact is normally open and closes when the alarm is triggered, and (b) NC, in which the contact is normally closed and opens when the alarm is triggered.

A delay has been incorporated which allows time between setting the alarm and vacating the property and between entering the property and disabling the alarm. In the latter case, a pre-alarm buzzer sounds and an LED lights to indicate that the alarm has been triggered. This arrangement is also very useful for testing the alarm. The LED remains on when the alarm has been set off.

The intruder alarm works off the mains, but a 12 V battery is included as back-up during mains failure.

Basic configuration

As soon as switch S_1 (preferably a key-operated type) in Figure 1 is closed, diode D_4 lights and monostable MMV_1 generates a reset pulse that triggers MMV_2 whose $\overline{Q}$ output then becomes logic 0. This logic level prevents an alarm pulse from interface I reaching monostable MMV_3, at least for the time being. When the alarm is in this delay phase, diode D_9 (see Figure 3) lights, but the alarm is not yet triggered. When MMV_2 toggles, D_9 goes out and MMV_3 is enabled. In this condition a pulse from interface I will trigger MMV_3 which causes its $\overline{Q}$ output to go low. This results in bistable FF_1 being set, diode D_3 commencing to blink, and a buzzer starting to sound: this is the pre-alarm phase. Only when MMV_3 returns to its stable state, i.e., after a further delay, is monostable MMV_4 triggered. The second delay makes it possible to enter the property and switch off the alarm before it has sounded. As soon as S_1 is switched off, D_3 stops blinking, MMV_3 is disabled, and the alarm is reset. The various pulses mentioned here are shown diagrammatically in Figure 2.

Circuit details

The pulses mentioned in the previous paragraph are also shown on the circuit diagram in Figure 3. Terminal 2 on this diagram is the input from the anti-tamper circuit. This line is one of the wires in the multicore connecting cable between the sensor and the interfaces board. This arrangement ensures that cutting this cable by a potential intruder does not disable the alarm, but rather the contrary,

1

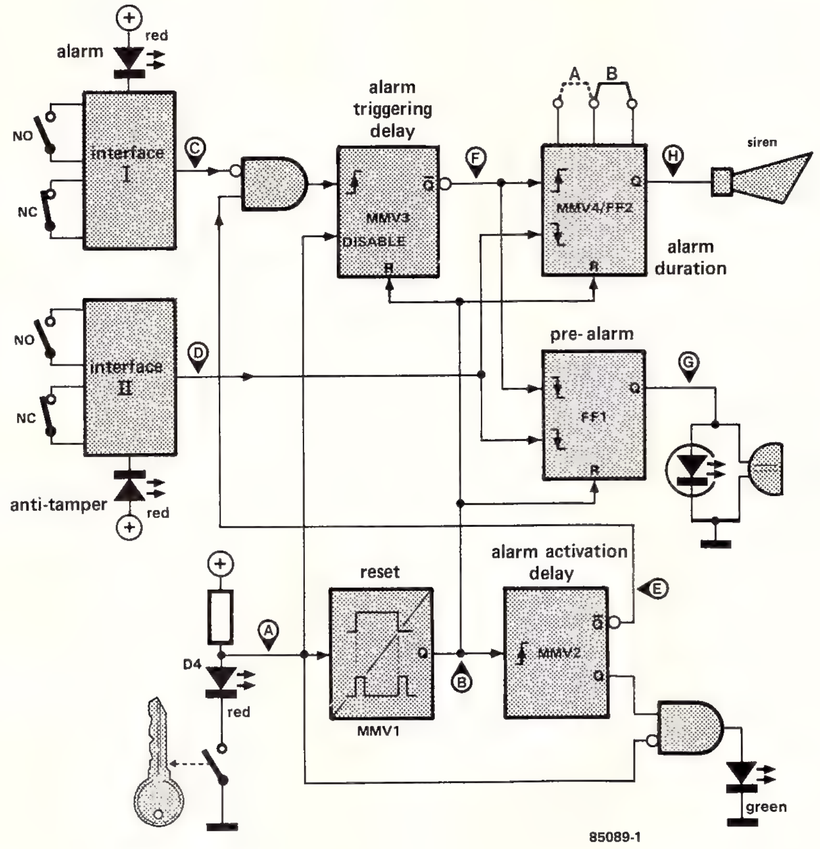

Figure 1. Block diagram of the intruder alarm with two interfaces.

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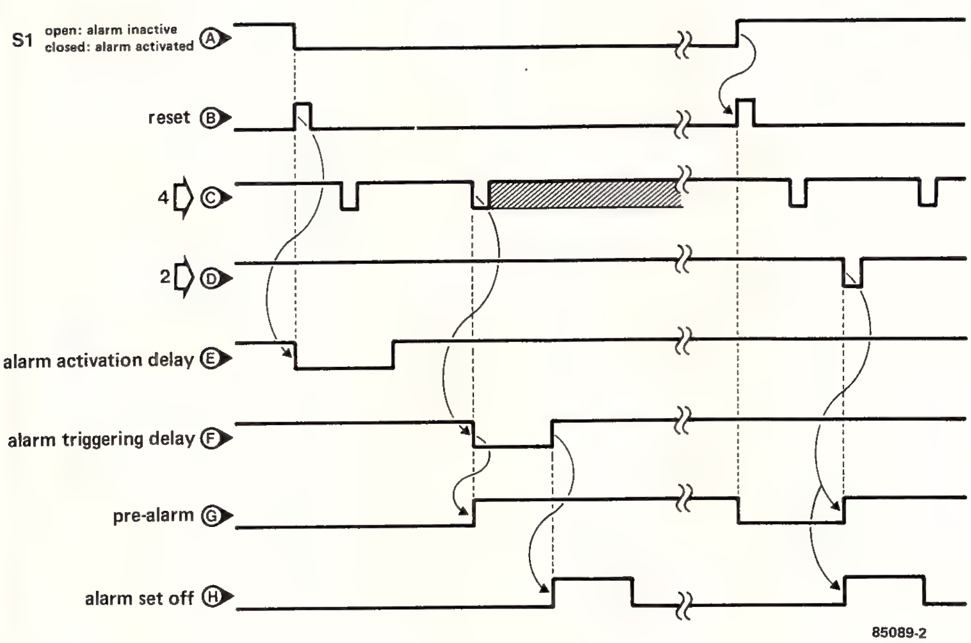
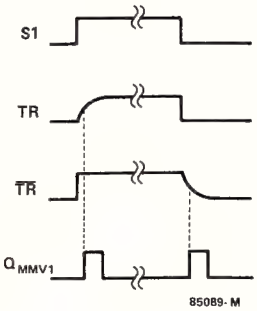


Figure 2. Pulse timing diagram.



because the anti-tamper circuit is connected direct to the board, bypassing switch S_1.

When a pulse from one of the sensors has arrived at the output of MMV_4, or bistable FF_2 has received a clock pulse from MMV_3, bistable FF_2 is set. Output Q then becomes, and remains, logic 1, which prevents MMV_4 being triggered again. At the same time, the output pulse is amplified in T_1 and then used to energize relay Re_1. At this instant the siren will sound.

The length of time that the relay remains energized may be preset between 10 seconds and 4 minutes by P_2. If link B has been made, the siren will switch off after this time has lapsed; the unit can only be reset by switching off S_1 and then closing it again. If, however, link A is used, the alarm will sound again and again until the unit is switched off. This arrangement ensures that the unit conforms to regulations in many areas where an alarm may not sound longer than three minutes and may not automatically switch itself on again.

Reset circuit MMV_1 generates a pulse at its Q output whenever S_1 is opened (rising edge at TR) or closed (falling edge at TR).

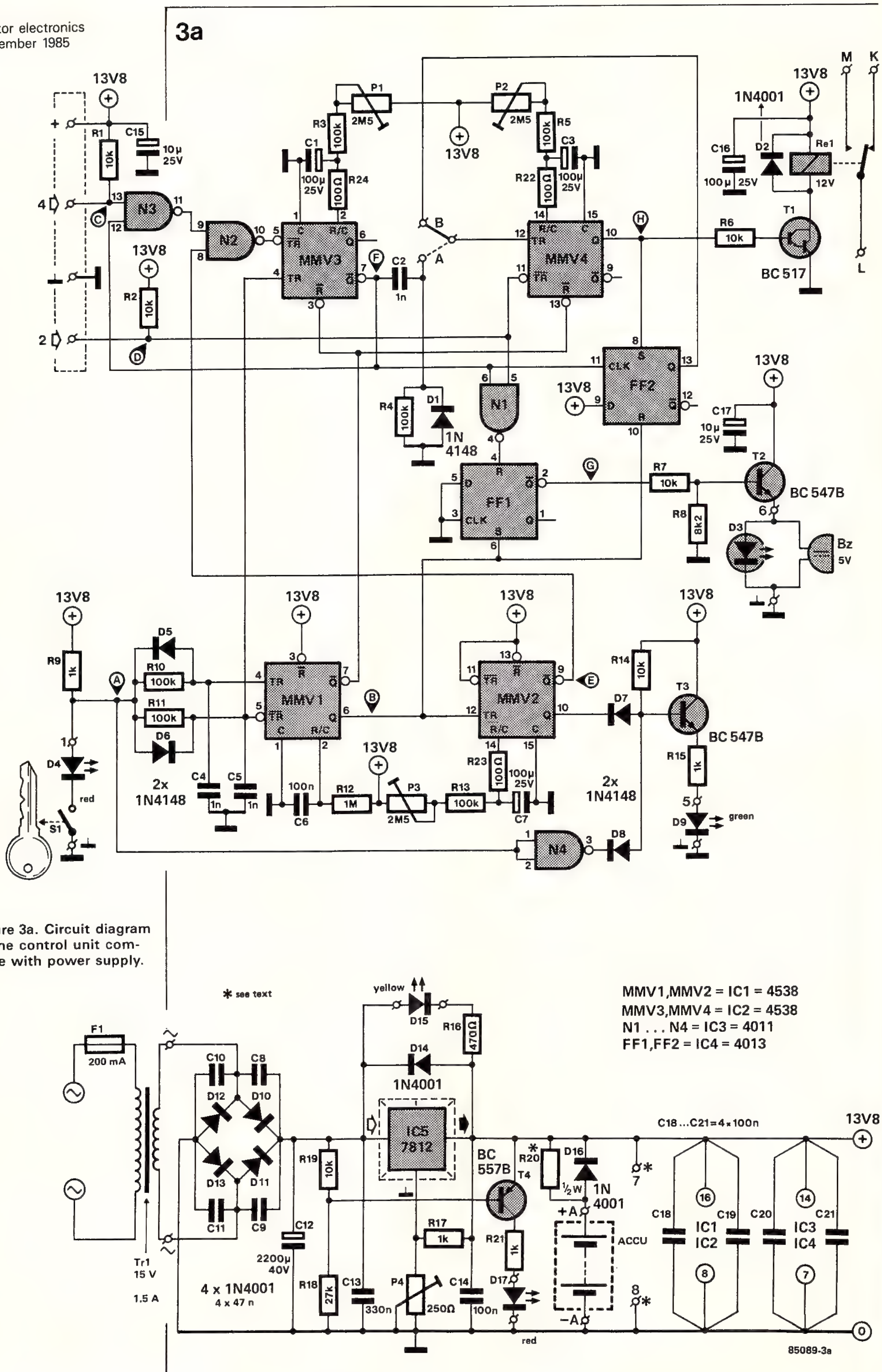


Figure 3a. Circuit diagram of the control unit complete with power supply.

3b

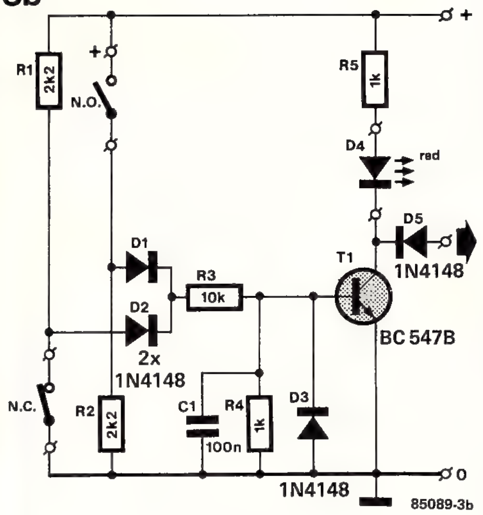


Figure 3b. Circuit diagram of an interface.

Power supply

The power supply — see Figure 3a — is rather more elaborate than usual, because it includes protection against mains failure. To this end, it contains two LEDs: an amber one, D_{15}, to indicate operation from the mains, and a red one, D_{17}, to show when the unit works from the battery.

During mains operation, the potential at the input of IC_5 is higher than that at the output, so that D_{15} lights. As the voltage across C_{12} is about 19 V, the potential at the junction of R_{18} and R_{19} is around 14 V; T_4 is then off, and D_{17} does not conduct. When the mains fails, T_4 conducts and D_{17} lights.

It is best to use a 12 V lead-acid battery with a capacity of about 1 Ah: diode D_{16} may then be omitted, and R_{20} should be replaced by a wire link. It is, however, also possible to use a 12 V NiCd battery with a capacity of 0.5 Ah: in that case, D_{16} must then be connected as shown, whereas R_{20} should be omitted. When the batteries are not in use, they are trickle charged automatically.

Interfaces

The interfaces, the circuit diagram of which is given in Figure 3b, offer two operating conditions, as stated before. NO contacts should be connected in parallel; NC contacts, in series. A secondary function of the interfaces is to prevent noise generated in long leads from reaching the control circuits.

A number of interface boards may be connected in parallel: an AND gate is then formed by diode D_5 on the interface board and R_1 or R_2, as the case may be, on the control board. This means that when one of the interface boards provides a logic 0, the relevant input of the control board is also logic low. It is thus possible

4

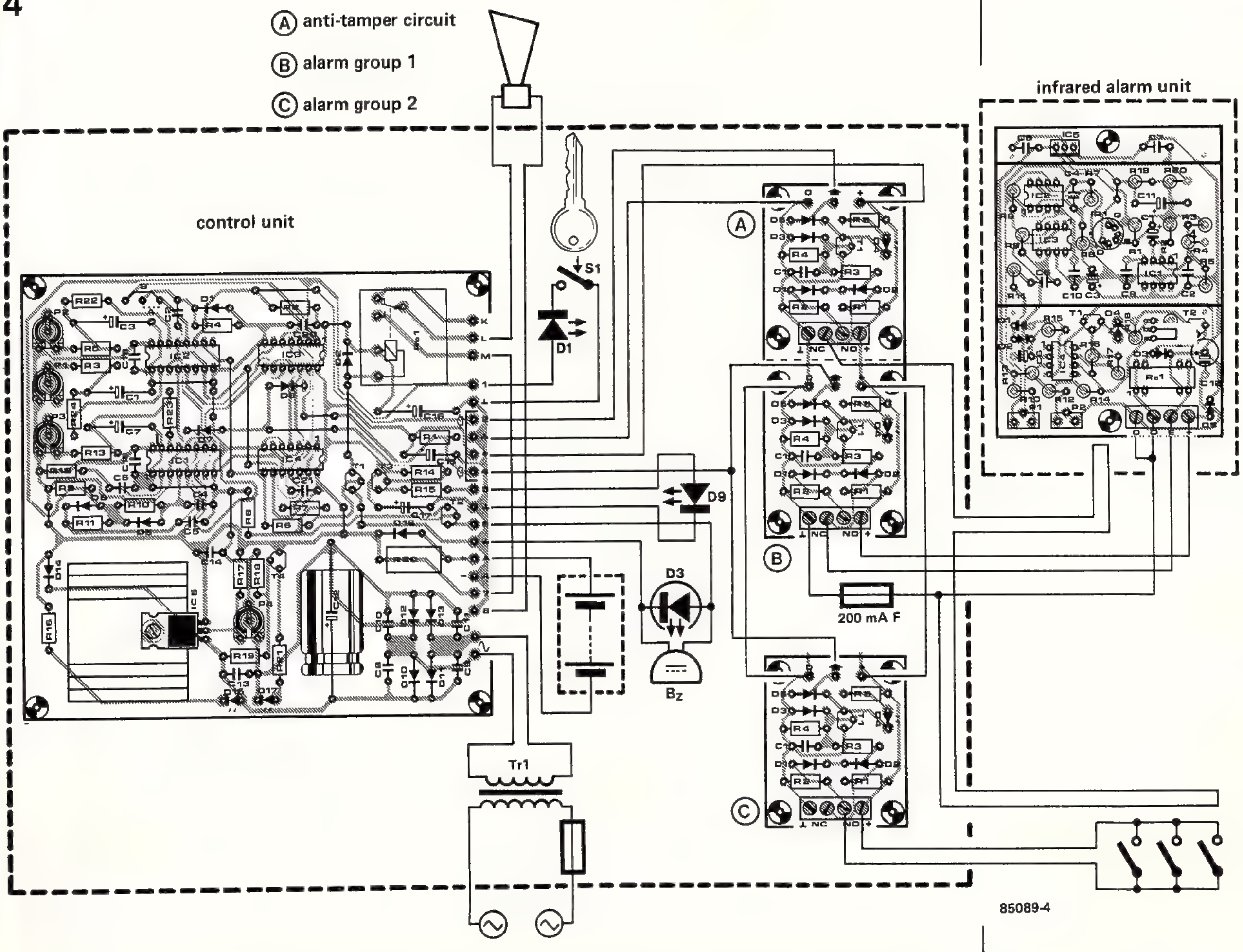


Figure 4. Wiring diagram of the intruder alarm.

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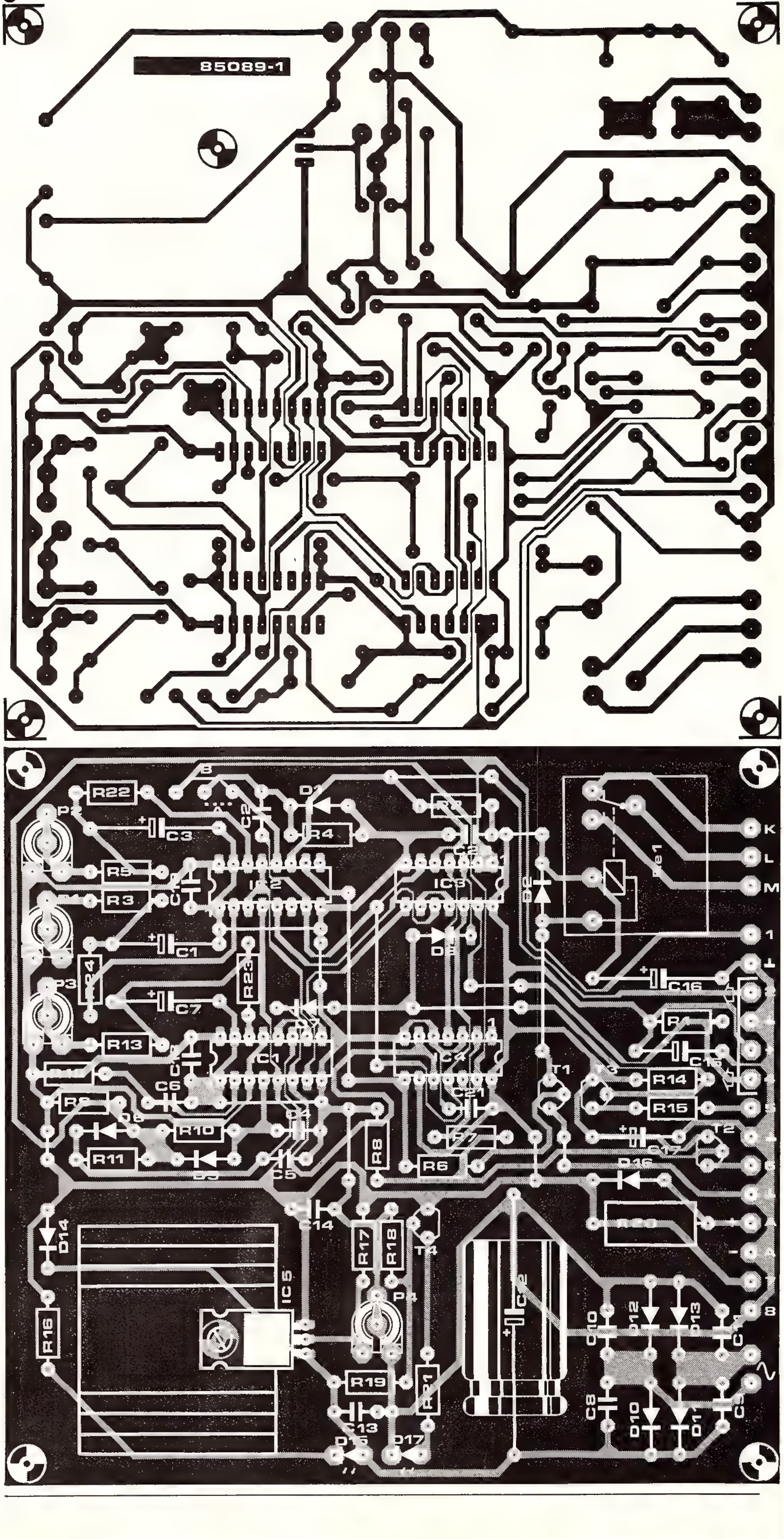

Parts list

Resistors:

R_1;R_2;R_6;R_7;R_{14};R_{19} = 10 k
R_3...R_5;R_{10};R_{11};
R_{13} = 100 k
R_8 = 8k2
R_9;R_{15};R_{17};R_{21} = 1 k
R_{12} = 1 M
R_{16} = 470 Ω
R_{18} = 27 k
R_{20}* = 120 Ω; ½ W
R_{22}...R_{24} = 100 Ω
P_1...P_3 = 2M5 preset
P_4 = 250 Ω preset

Capacitors:

C_1;C_3;C_7;C_{16} = 100 μ; 25 V
C_2;C_4;C_5 = 1 n
C_6;C_{14};C_{18}...C_{21} = 100 n
C_8...C_{11} = 47 n
C_{12} = 2200 μ; 40 V
C_{13} = 330 n
C_{15};C_{17} = 10 μ; 25 V

Semiconductors:

D_1;D_5...D_8 = 1N4148
D_2;D_{10}...D_{14};
D_{16}* = 1N4001
D_3 = flashing LED; 5 V*
D_4;D_{17} = LED; 5 mm; red
D_9 = LED; 5 mm; green
D_{15} = LED; 5 mm; amber
T_1 = BC517
T_2;T_3 = BC547B
T_4 = BC557B
IC_1;IC_2 = 4538
IC_3 = 4011
IC_4 = 4013
IC_5 = 7812

Miscellaneous:

S_1 = SPST switch: preferably key operated
F_1 = miniature fuse; 200 mA; delayed action
Tr_1 = mains transformer: secondary 15 V; 1.5 A*
Re_1 = relay for PCB mounting; e.g., Siemens V23027-A0002-A... (may be available from Electrovalue Ltd, Englefield Green, Egham, Surrey TW20 0HB; telephone 0784 33603 or 680 Burnage Lane, Manchester M19 1NA; telephone 061 432 4945)
Bz = DC operated piezo buzzer; 5 V; I_{max} = 25 mA; with integral oscillator
Heat sink for IC_5; 5 K/W
12 V (nominal) battery*
PCB 85089-1

*See text

Figure 5. Printed-circuit board of the control unit.

Parts list

Resistors:
R_1;R_2* = 2k2
R_3 = 10 k
R_4;R_5 = 1 k

Capacitor:
C_1 = 100 n

Semiconductors:
$D_1 \ldots D_3$;D_5 = 1N4148
D_4 = LED; 5 mm; red
T_1 = BC547B

Miscellaneous:
4-way PCB terminal block (Verospeed — phone 0703 644555)
PCB 85089-2

Note that these parts are sufficient for one interface only.

*See text

6

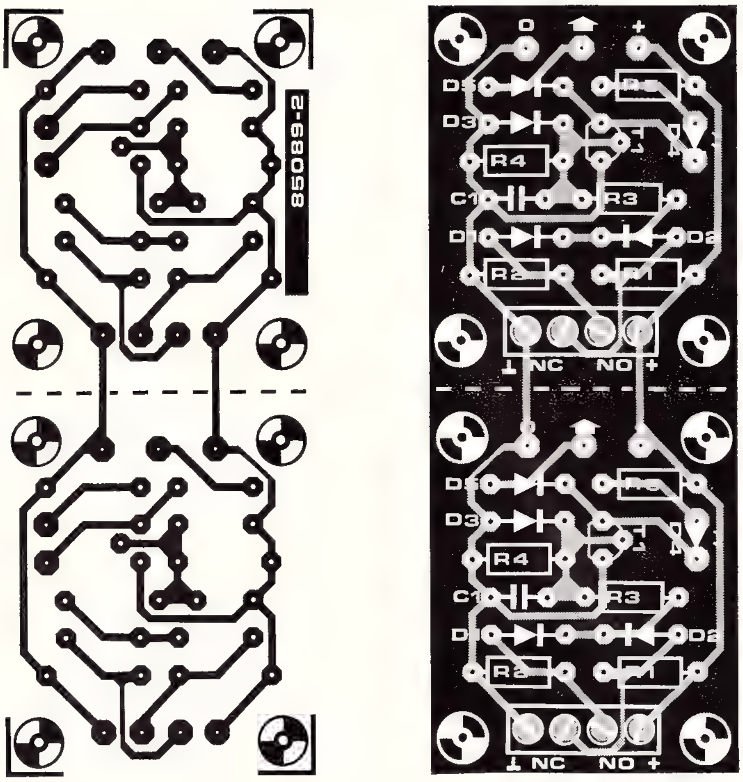

Figure 6. Printed-circuit board for two interfaces.

to use quite a number of sensors — see also the wiring diagram in Figure 4. Each interface has its own positive and negative supply connections, which are used in the first instance for the NO or NC contacts. They can, however, also be used for supplying power to the infra-red sensors. It is advisable to fit a 200 mA miniature fuse in the negative supply line to prevent short circuits between the two supply lines in case the cable is cut.

Switch S_1 is normally fitted at the control unit; if it is required to be located elsewhere, a separate interface as in Figure 3b has to be used. The switch, still in series with D_4, is then connected between the NO terminals on the interface (anode of D_4 to +!). Interface terminals 0, output, and + should be connected to control board terminals 8, 1, and 7 respectively. The value of R_2 in Figure 3b must be lowered to 1 kΩ.

Construction and test

The printed-circuit boards for the control unit and the interfaces are illustrated in Figures 5 and 6 respectively: note that the latter is intended for two identical interfaces.

If diode D_3 is not required to blink, solder a 100 nF capacitor across the buzzer.

The power supply has been designed for use with a 12 V 6 W siren; if a 240 V siren is used, the rating of Tr_1 may be reduced to 15 V; 0.5 A.

Interconnections between the boards are shown in the wiring diagram of Figure 4 which illustrates the use of 1½ interface board.

The control unit should be housed in a suitable, robust metal case as shown in the photograph.

Before fitting the battery, adjust P_4 to give a voltage of 13.8 V across terminals 7 and 8. Then fit the — fully charged! — battery. Close S_1 when D_9 should light and shortly afterwards go out again. The lighting time is preset between 10 seconds and 4 minutes with P_3.

Test the anti-tamper circuit by opening an NC contact or closing a NO contact: relay Re_1 should then be energized; D_3 should blink (unless a 100 nF capacitor has been provided across the buzzer); and the buzzer should sound. The holding period of the relay, i.e., the length of time the alarm sounds, is preset with P_2. Note that $P_1 \ldots P_3$ have minimum value when they are turned fully anticlockwise.

When a normal alarm group receives a pulse from a sensor, nothing should happen immediately; if, however, the anti-tamper circuit receives a pulse, the alarm should be set off immediately. A normal alarm group can only trigger the alarm when S_1 is closed: this happens after a delay of between 10 seconds and 4 minutes — preset with P_1 — when relay Re_1 is energized.

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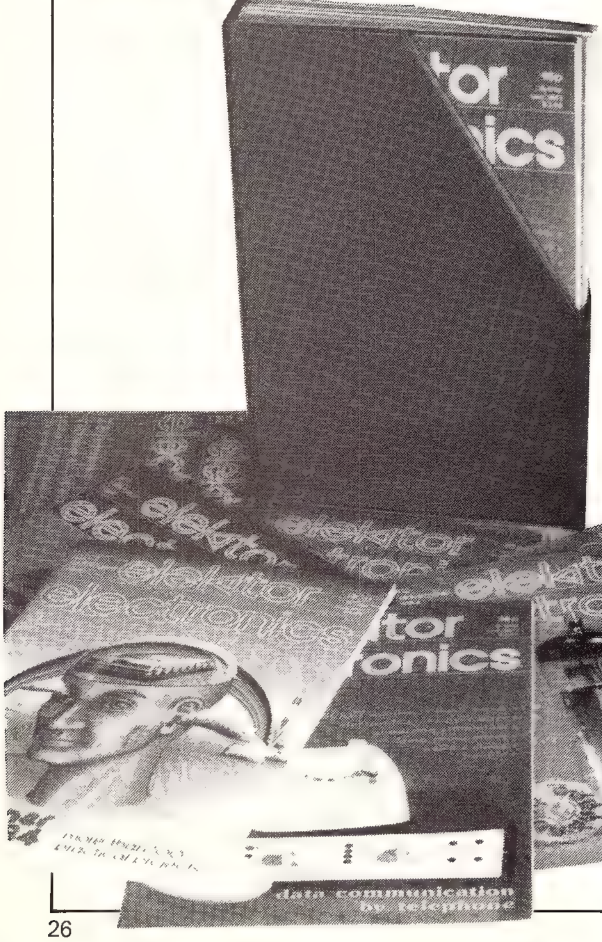

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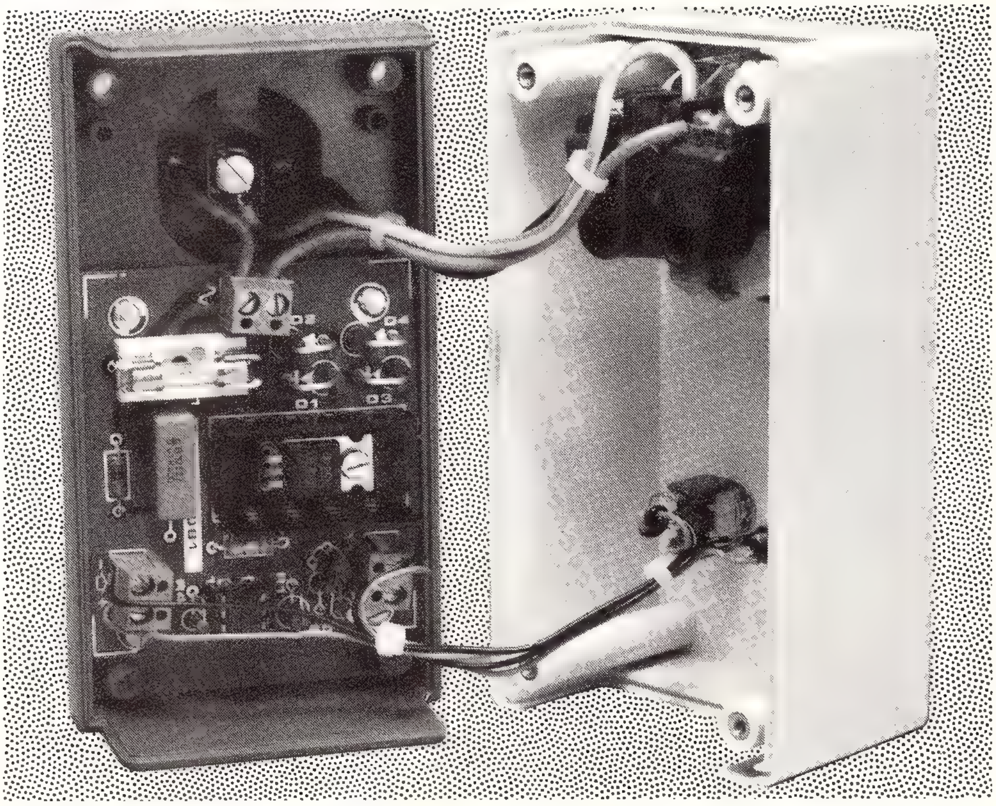

solid-state relay

In general, mains-operated loads are switched by electromagnetic relays. Such relays have been in use for many years and are, in the main, reliable and sometimes ingenious. None the less, they are slowly but surely being superseded by their even more reliable electronic counterparts. A further advantage of these solid-state devices is that they are becoming less expensive than electromagnetic relays. This article describes a simple solid-state relay for switching ohmic loads of up to 600 watts.

J Steeman

Electromagnetic relays have one or several sets of contacts which open or close when a soft-iron core is magnetized by a coil around it.

Solid-state relays involve no mechanical movement whatsoever, as switching is effected by a single silicon-controlled rectifier (SCR) or two SCRs in a common envelope — normally called a triac. This type of relay is of great importance in digital circuits. Note that the SCR was originally called thyristor.

Solid-state relays have a much better lifespan than electromagnetic types, particularly at high rates of switching. They also exhibit far less electrical noise and may be used in explosive environments since there are no contacts across which arcs can form. And, of course, they are completely free of mechanical noise.

The basic concept of a solid-state relay is shown in Figure la. The switch may take the form of an SCR in a bridge circuit as in Figure lb. This configuration enables both the positive and the negative halves of the mains voltage to be switched.

Switching noise

When the moment of switching does not coincide with a zero crossing of the mains, the sudden change in current causes high-frequency impulse noise, which, for instance, may result in unwanted signals appearing on the screen of a television receiver, or becoming audible as clicks in the loudspeaker of a radio receiver.

The magnitude of the noise depends on the frequency of switching, on the instant relative to the zero crossing when switching takes place, and on the type of load being switched: it is generally greater with inductive or capacitive loads than with ohmic loads.

Switching at zero crossing

In a silicon-controlled rectifier, SCR, the forward anode-cathode current is controlled by a signal applied to a third electrode, called the gate. When a positive current is applied to the gate, and the anode is positive with respect to the cathode, current flows through the SCR from anode to cathode. The magnitude of the gate current determines the breakover point, i.e., the anode voltage at which the SCR switches from the blocking to the conducting state. The SCR conducts as long as the current through it is greater than the so-called holding current.

This means that in a.c. applications the SCR switches off when the mains passes through zero. Consequently, a positive current (pulse) must be supplied to the gate at every half period of the mains voltage to ensure continuous conduction.

For ohmic loads, the correct moment of applying the pulse to the gate is when the mains voltage passes through zero, since for such loads the voltage and current are in phase. With inductive and capacitive loads, voltage and current are not in phase, and it is, therefore, not correct to trigger the gate when the mains voltage passes through zero. The optimum trigger moment for such loads is rather more difficult to determine.

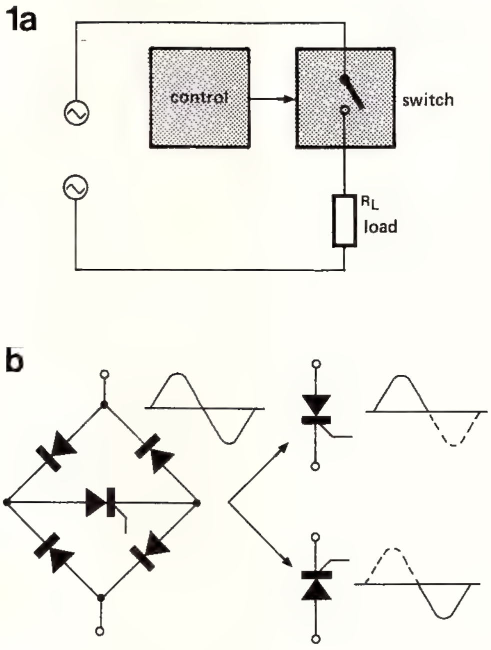

Figure 1. Basic concept of a solid-state relay. The switch in Figure 1a is formed in the present unit by four diodes in a bridge arrangement and a silicon-controlled rectifier as shown in 1b.

Solid-state relay

The circuit of the solid-state relay is given in Figure 2. It is triggered at the zero crossing of the mains voltage and is, therefore, only suitable for use with ohmic loads.

The relay is driven via an opto-isolator, so that the control unit (computer, time switch, and so on) is electrically isolated from the mains.

The main current loop is closed via load La, bridge rectifier $D_1 \ldots D_4$, silicon-controlled rectifier Th_1, and fuse F_1. The maximum forward current through the diodes is 3 A, while the SCR is rated at 5 A.

When the SCR is in the blocking state, the entire full-wave rectified mains voltage is present across it. At every zero crossing of the mains voltage, transistor T_1 produces a positive current pulse, provided switch S_1 is open and the phototransistor in IC_1 is off. When the instantaneous voltage at the gate is sufficient to switch the SCR on, the voltage across the SCR, and consequently that at the gate, drops to zero. As long as the above provisions are met, this action repeats itself at every zero crossing of the mains voltage. The various situations and associated voltages are shown in Figure 3. With both S_1 and IC_1 off, the SCR conducts, i.e., the relay is actuated. It may be switched off by closing S_1, or by applying a voltage of +5 V to the series combination of R_4 and the LED in IC_1. The opto-

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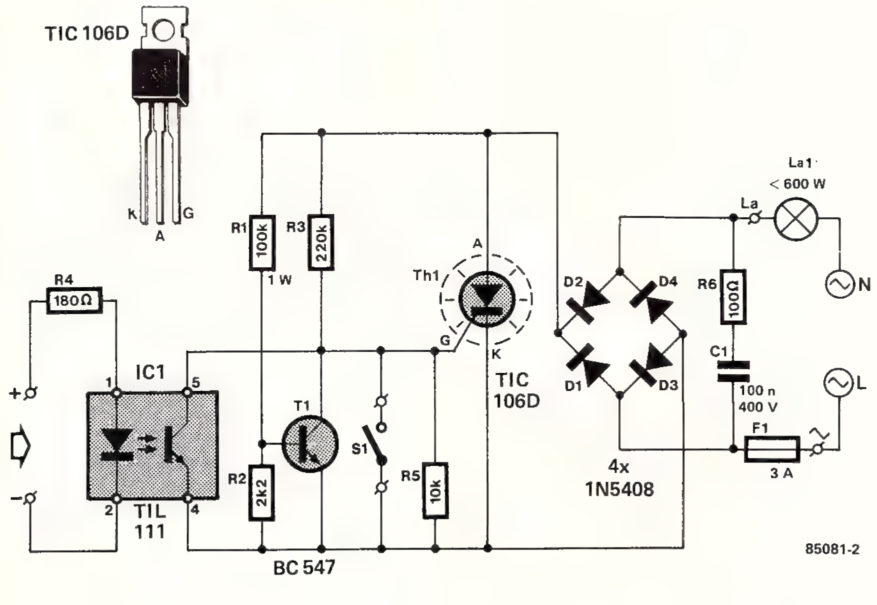

Figure 2. The circuit of the solid-state relay, which, in essence, replaces the usual mains switch. Note that all parts carry the mains voltage!

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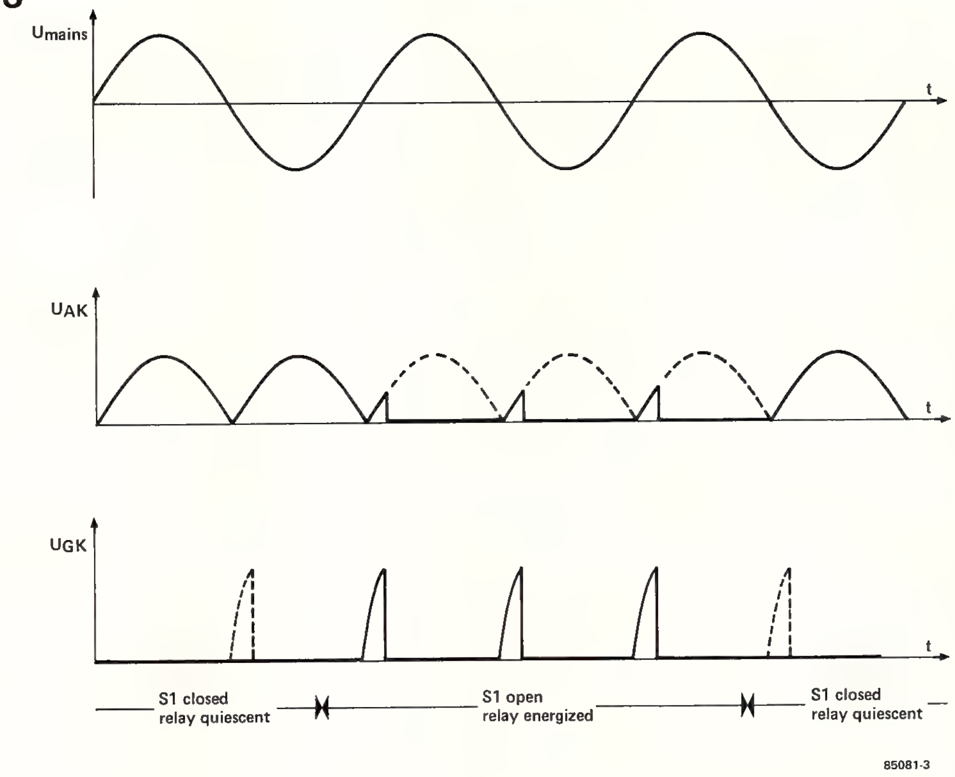

Figure 3. Schematic representation of various operating conditions and associated voltage waveforms.

isolator may be controlled by TTL (transistor-transistor logic), but also by other signals. Note that the maximum forward current through the diode should not exceed 100 mA, while the reverse bias should be not greater than —3 V.

Construction

The relay is most conveniently built on the PCB illustrated in Figure 4. This board is intended for fitting in a 120 x 65 x 55 mm plastic case, which results in a neat and compact unit. The connections to the switch, control unit, mains, and load are best made with the aid of nylon dual terminal blocks. This makes it possible for the PCB to be fitted, or removed, without the need for soldering. The SCR should be mounted on a small heat sink. Because the unit works from, and with, mains voltages and relatively high currents, great care should be taken in the wiring. Do not forget the earth connection between the mains outlet and the unit! Switch S_1 and the input connectors for the control voltage are mounted at the top of the case. Remember that the switch should always be open when external control is used.

Finally

This solid-state relay is intended for use with ohmic loads of up to 600 W. It cannot be used for switching transformers, neon tubes, and other inductive or capacitive loads, because this would upset the triggering system.

Parts list

Resistors:
R_1 = 100 k; 1 W
R_2 = 2k2
R_3 = 220 k; ½ W
R_4 = 180 Ω
R_5 = 10 k
R_6 = 100 Ω

Capacitor:
C_1 = 100 n; 400 V

Semiconductors:
$D_1 \ldots D_4$ = 1N5408
IC_1 = TIL111
T_1 = BC547B
Th_1 = TIC106D

Miscellaneous:
F_1 = 3 A; delayed action; complete with fuse holder for PCB mounting
Heat sink SK13 or KL105 for Th_1
S_1 = SPST switch
Plastic case, 120 x 65 x 55 mm; e.g., OKW 9022487 (may be available from Verospeed — 0703 644555)
3 nylon dual terminal blocks
PCB 85081

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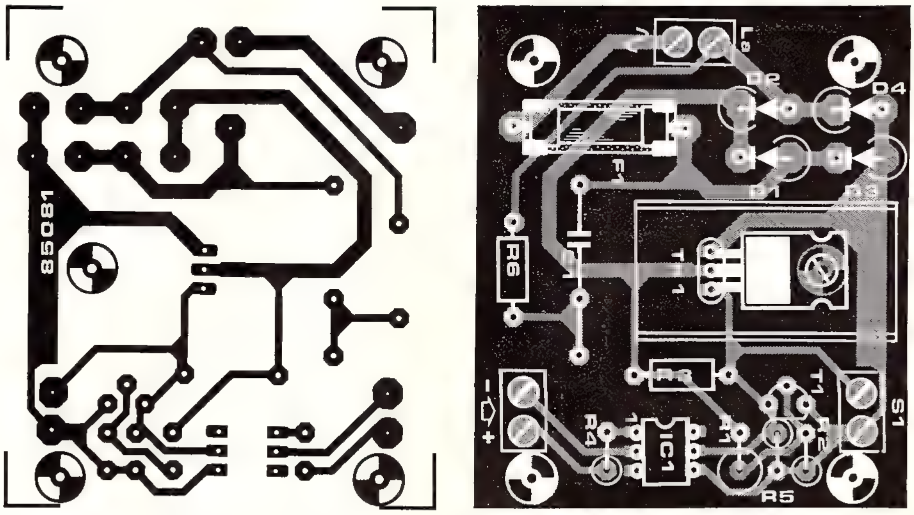

Figure 4. The printed circuit for the solid-state relay.

companies

Heiland Electronic

Apart from providing an electronics design and development service, Heiland Electronic also produce a range of eminently practical, transparent equipment cases (see, for instance, the front cover of *elektor electronics*, April 1985), and prototyping boards. The company is seeking representation in the United Kingdom and would welcome any inquiries in this respect.

Heiland Electronic
Hermann-Löns-Strasse 11
D-4410 Warendorf 3
German Federal Republic
Telephone: 010 49 2582 7550

Yuasa Battery (UK) Limited

Yuasa Battery (UK) Ltd have announced a major expansion of its existing operations in Ebbw Vale, South Wales. This expansion will cost more than £10m and will be located in a new 9300 m² facility to be leased from the Welsh Development Agency.

Three hundred new jobs are expected to be created in addition to the present 160 already employed in Yuasa's existing 5800 m² factory at the Rassau Industrial Estate.

Yuasa Battery (UK) Ltd
Hawksworth Industrial Estate
Swindon
Wiltshire SN2 1DZ
Telephone: (0793) 486818/9
Telex: 449754

Advance buys House of Instruments

Advance Power Supplies Limited, the leading UK power supply manufacturer formed in April 1984 as a result of a management buy-out of the former Gould Power Conversion Division, has purchased instrument distributor House of Instruments.

Advance, which sees the move as a major step forward in its expansion and diversification plans, is moving the existing House of Instruments operation from Saffron Walden to its Bishop's Stortford headquarters. Advance is committed to providing continuity for existing House of Instruments customers, and the sales staff are remaining with the company.

For the future, Advance intends to invest considerably in House of Instruments, both in terms of higher stocking levels to ensure speedier service and in completely new product lines and services.

Advance Power Supplies Ltd
Raynham Road
Bishop's Stortford
Hertfordshire
Telephone: (0279) 55155
Telex: 81510

Fortune Systems enters India market

Fortune Systems Corporation of Belmont, California, has entered into a number of agreements with members of the Kirloskar Group of Companies, one of the seven largest corporate groups in India. These agreements are for the transfer of software and hardware manufacturing technology and for the establishment of a software development and porting facility in India. As a result, Kirloskar will become the exclusive distributor of Fortune hardware and software in India, and will have distribution rights in other Asian countries.

The first agreement is with Kirloskar Computer Services Limited of Bangalore, and entails a $2.2m contract for Fortune's FOR:PRO operating system, language compilers, and development tools. Fortune believes this to be the first sale of US source code to an Indian manufacturers to receive approval from the Indian Government.

Under a separate, four-year agreement, Kirloskar Computers Services will carry out software development and porting for and on behalf of Fortune Systems. The development facility will supplement Fortune's domestic engineering efforts, will spread Fortune's UNIX-based operating system to other Indian microcomputer manufacturers, and will develop applications software specifically aimed to meet Indian business needs.

Fortune Systems Corporation designs, manufactures, and markets office and computer systems based on the UNIX operating system, and is a leader in the commercial application of UNIX with 40 000 workstations installed world-wide.

UNIX is a trademark of AT&T Bell Laboratories Inc.

PC program library for designers

Data Technology AB of Danderyd, Sweden, has opened a London office to provide a library of personal computer programs for technical Personal computers are now so well developed that they are capable of carrying out a wide range of complicated tasks previously only possible with main frame computers. This means that they can be used by an ever growing number of engineers in everyday designing, administration, and planning.

designers in all branches of engineering. Manager for the London office is Mr Christopher Turner.

Chris Turner, Manager Datatech, London

By the end of this year, Data Technology expects to have available some 150 programs. Already available are programs for advanced project planning, sizing, simulation of electronic circuits, statistical calculation and design, and three-dimensional model design.

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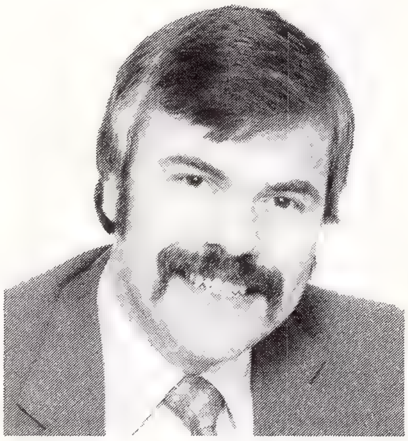
Opto-electronics specialists

Earlier this year, Regisbrook Limited, founded in 1982 by Chris and Cathy Williams, officially opened its new corporate headquarters in Pangbourne, Berkshire. By then, the company had reached a turn over of £1m; forward orders guarantee double that amount in 1985.

Cathy Williams, Managing Director

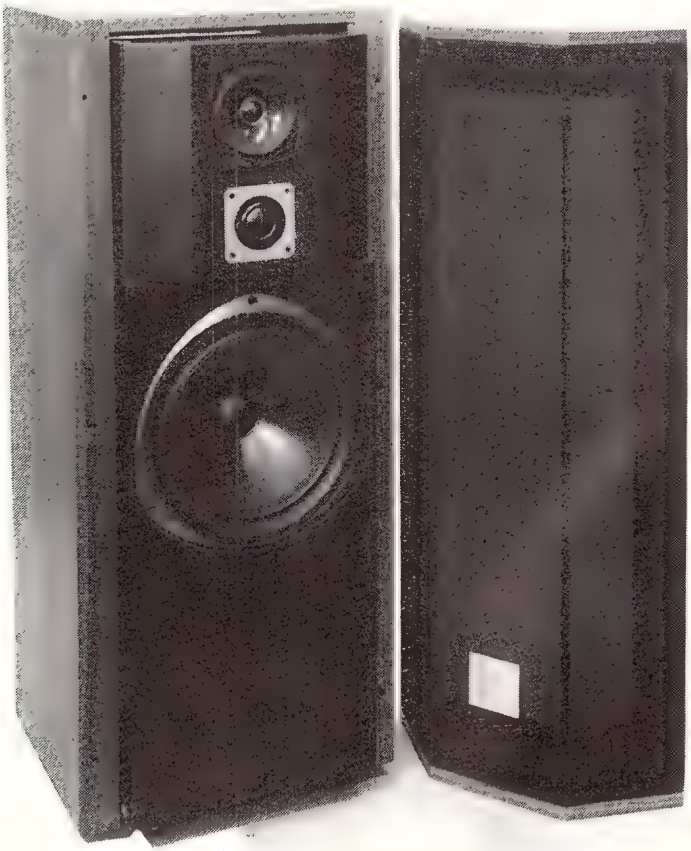
A manufacturing offshoot, Pulseview Limited, started operations some time ago with £500 000 start-up capital from three major City of London institutions. The company, based at Abingdon in Berkshire, will concentrate on advanced opto-electronic design and testing. More recently, Regisbrook created a new division of the company to service their expanding market in defence and aerospace industries. Regisbrook Defence Electronic Components and Systems (Regisbrook DECS) will operate as an autonomous part of the company, while sharing the parent's facilities and expertise in display and visual technology.



Chris Williams, Chairman & Sales Director

Regisbrook have exclusive distribution agreements with a number of manufacturers, such as the JKL Components Corporation of California (miniature fluorescent lamps); Taylor-Williams (display modules); Kappa Messtechnik of West Germany (advanced miniature camera systems); and Futaba Corporation of Japan (graphics panels).

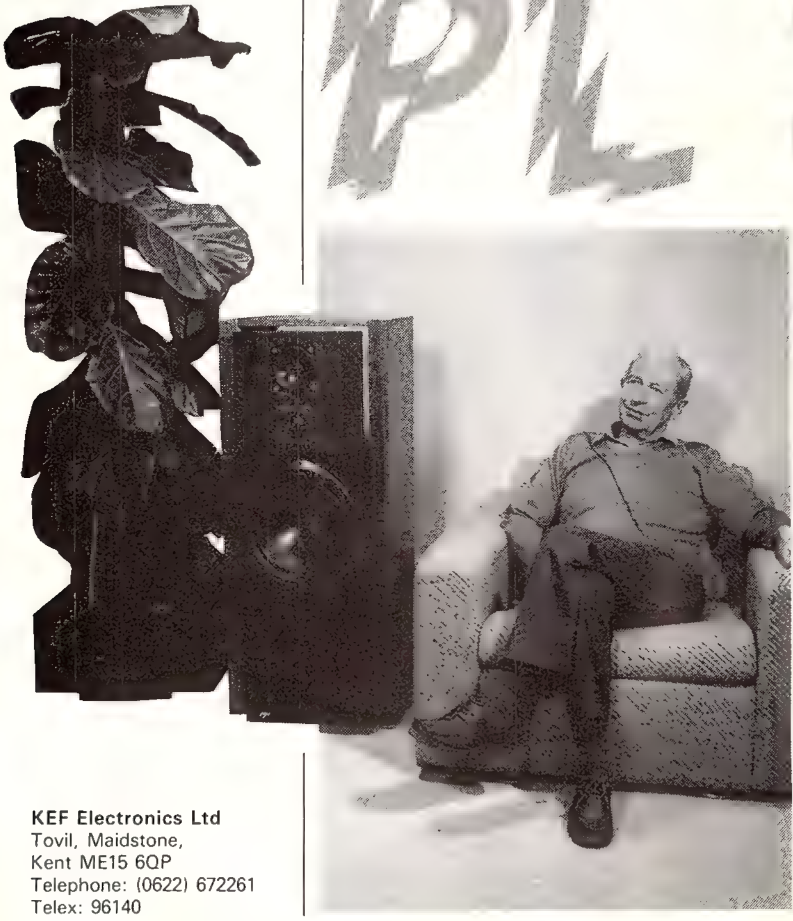
Regisbrook Limited
Unit 5
Horseshoe Park
Pangbourne
Berkshire
Telephone: (07357) 4841
Telex: 849013



PL 301

a loudspeaker for music lovers

The pleasure derived from music is heavily dependent on clarity. Although we may sometimes listen to live music, most of what we hear nowadays is recorded, so that even the finest musical sounds will be spoilt if the reproduction lacks fidelity or if they are accompanied by irritating noises and distortion. The item that most often lets the sound reproduction equipment down is the loudspeaker. But not the PL301, which has been designed by KEF Electronics Limited, the well-known loudspeaker designers and manufacturers from Maidstone. KEF has an international reputation for high-quality products and has, moreover, been active successfully in the DIY market for many years. This means that their products are readily available in most of the western world. Cogent reasons for building the PL301, which may not be the cheapest KEF design, but is certainly among the best!



The PL301 is a passive, three-way system. Externally, it catches the eye because of its unusual shape. In finished form, it is partly filled with sand, which makes it quite heavy. Its reproduction is characterized by strict neutrality and precision, resulting in a natural, lively sound.

Design considerations

Designing a loudspeaker box is no sinecure, since there is no detail that is not important or does not play a role in the finished product. The loudspeaker frame, the shape of the enclosure, the volume of the box, the positioning of the frame in the box, the damping, the filter, impedance correction networks, filter components — all these have to be carefully matched to one another.

KEF realized all this a long time ago. Their loudspeaker designs never have just one outstanding property, as is often the case with those of other manufacturers: the

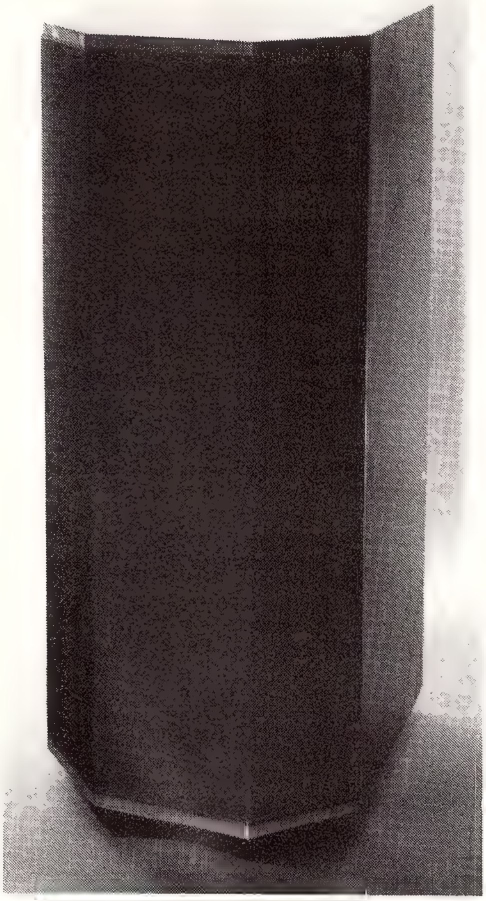
KEF Electronics Ltd
Tovil, Maidstone,
Kent ME15 6QP
Telephone: (0622) 672261
Telex: 96140

complete design is good. And that is certainly the case with the PL301: no outstanding strong individual points, but no weak ones either! Technical characteristics are given in Table 1.

The PL301 is a good-size three-way system in, as usual with KEF designs, a closed acoustic box. The cross-over between bass, middle, and treble frequencies is provided by a Linkurtz-Riley filter with an initial slope of 18 dB per octave.

The enclosure contains two separate compartments: one for the bass speaker, and one for the middle frequency speaker and tweeter. At first sight, this basic design looks very similar to the RR105, the most pretentious of KEF's loudspeaker enclosures. Even the speakers themselves are the same as in that model. On that basis you might think that the present design is a sort of updated or perfected (is that possible?) RR105, but you would be wrong, because the PL301 has a number of characteristic details which put it a little outside the normal KEF family. Those details are concerned with the precise positioning of the loudspeakers, the shape of the enclosure, and its freedom of resonance — together resulting in a neutral, uniform reproduction and tightly controlled bass performance.

Building the enclosure(s) takes, of course, quite some time, but this is where the DIY enthusiast has the edge over the industrial producer. The home constructor does not consider the hours he puts into the work as part of the overall cost, and he is, therefore, able to carry out labour-intensive work that a manufacturer could not tackle at a profit.



Drive units

KEF have chosen what is probably their best three-way combination: the T52B tweeter, the B110B for the middle frequencies, and the B300B for the bass. These units are shown in the photograph in figure 1.

The bass speaker is one of the most recent additions to the KEF family. In earlier top-of-the-range designs, the 200 mm Type B200 or the well-known oval Type B139 was normally used. The B300B (SP1071) is a robust 300 mm unit with a resonance frequency of 23 Hz, and is

Table 1.

Technical characteristics

Frequency range	35 Hz...20 kHz ± 3 dB (see figure 13)
Maximum sound pressure	109 dB
Sensitivity	86 dB (1 watt at 1 metre)
Input power	not less than 15 watt not more than 200 watt
Impedance	8 ohms nominal (see figure 12)
Dividing network	3-way; 18 dB per octave; crossover frequencies 400 Hz and 3000 Hz
Drive units	low: KEF B300B (SP1071) middle: KEF B110B (SP1057) high: KEF T52B (SP1072)
Enclosure	closed acoustic box (3rd order)
Volume	bass compartment: 80 litres (0.08 m³) net middle and high compartment: 3 litres (0.003 m³) net
Dimensions	1050 mm high × 465 mm wide × 430 mm deep

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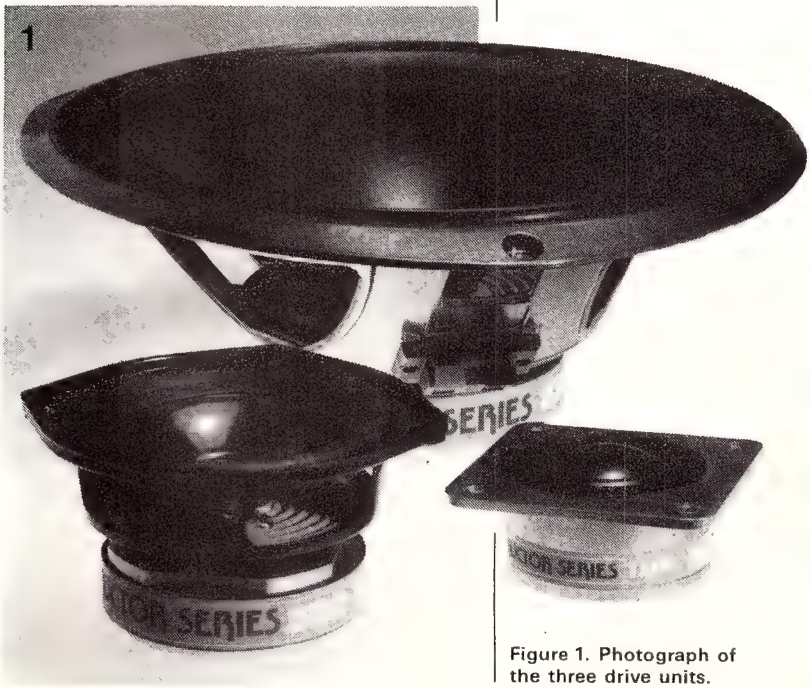

Figure 1. Photograph of the three drive units.

rated at an impressive 150 watt sine wave or 200 watt music.

The T52B (SP1072) tweeter has been in KEF's range rather longer. It has a relatively large cone (52 mm diameter), whereas the speech coil is somewhat smaller (37 mm diameter). Moreover, it has a pleasantly low resonance frequency of 650 Hz.

The old guard of the three is the B110B (SP1057) middle frequency unit. This 130 mm speaker has been produced by KEF for many years, and this makes it all the more amazing how well it still stands up to modern competition. Particularly as regards pulse performance, the B110B is second to none, as our own tests indicate.

Crossover network

Although KEF still used 12 dB loudspeaker dividing networks some years ago, nowadays all crossover networks have an 18 dB per octave characteristic. Modern computer-aided design has made it possible to tune these networks precisely to the relevant loudspeaker combinations. At the same time, these computer calculations give the required frequency and impedance correction factors.

The circuit diagram of the dividing network is shown in figure 2. The crossover points lie at 400 Hz and 3000 Hz respectively. The terminal voltages across the drive units (via the filter) are shown in figure 3.

Although we will revert to this later in the

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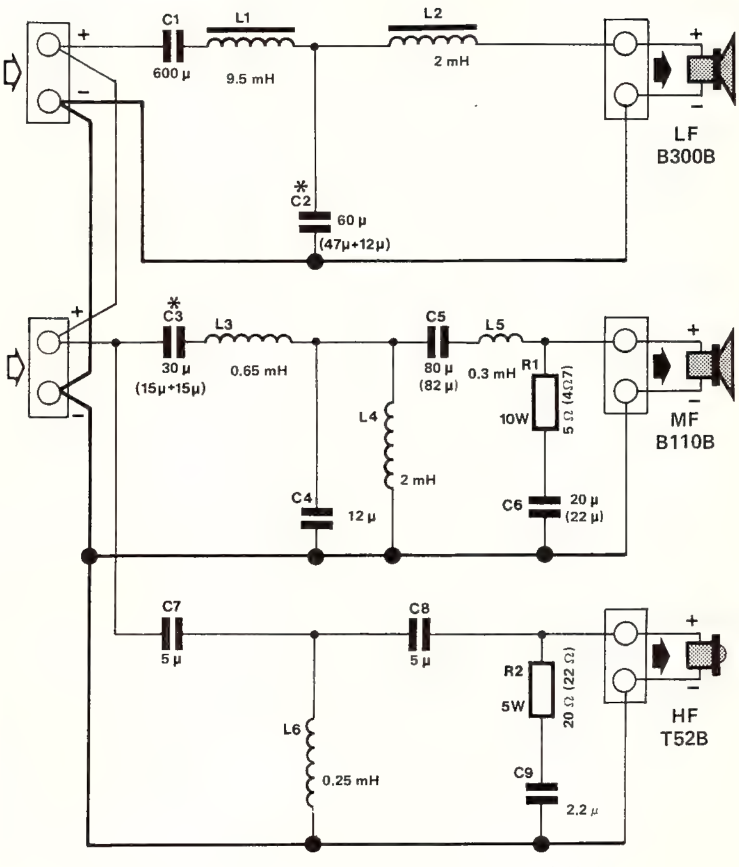

Figure 2. Circuit diagram of the crossover network.

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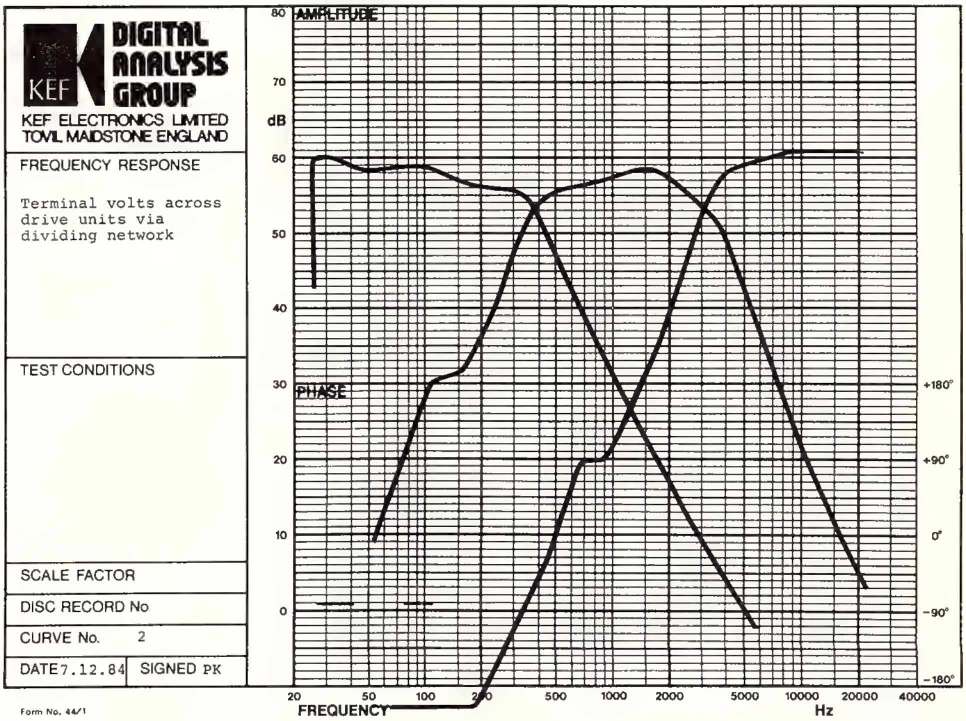


FREQUENCY RESPONSE

Terminal volts across drive units via dividing network

TEST CONDITIONS

SCALE FACTOR

DISC RECORD No

CURVE No. 2

DATE 7.12.84 SIGNED PK

Figure 3. Terminal voltages across the drive units via the dividing network.

article, note that we have designed two different printed circuit boards. The first version is intended for KEF components only, and this board is part of the crossover network kit available from KEF. The second version, shown in figure 6, is of more interest to the pure home constructor, since this is intended for components normally available from most electronics retailers.

According to KEF, bipolar electrolytic capacitors are not nearly as bad as is generally believed. Be that as it may, but note that they have taken the properties of such capacitors into account during the design calculations of their networks. This means that it is not possible to just replace these bipolar devices by foil capacitors. At low and middle frequencies, this is not much of a problem, since the audible differences between various types of capacitor in this range are virtually nil. Matters are quite different, however, at high frequencies: in our opinion a good foil capacitor here is definitely better than an electrolytic type.

We feel, therefore, that capacitors C_7 and C_8 should be polyester, polycarbonate, or (best) polypropylene foil types. The smaller losses in these capacitors, as compared with those in electrolytic types, cause the output of the tweeter to rise by almost 20 per cent, while the impedance characteristic descends somewhat at high frequencies. These effects can be negated by connecting a 0.5 ohm, 5 watt resistor in series with both C_7 and C_8.

Enclosure

The enclosure is divided into two compartments: one for the bass speaker, and the other for the middle and high frequency speakers, as shown in figure 7. As stated before, the PL301 is typified by its robustness, the individual placing of the drive units, and the shape of the enclosure.

The strength and rigidity is, of course, vital. Everything possible has been done in this design to prevent disturbing panel resonances. The material chosen is 22 mm plywood; there are numerous reinforcing struts, and, last but not least, the sides are double-panelled and the resulting hollows are filled with sand. It could not be better!

The remaining details worth mentioning reflect, without exception, the aim of obtaining optimum radiation of the sound. Noteworthy in this respect is the placing of the middle frequency speaker above the tweeter. Why this is done is illustrated in figure 4. When both these speakers are mounted in one plane and a line is drawn between the centre of the tweeter cone and the acoustic operating point of the middle frequency speaker, it is seen that in the conventional positioning shown in figure 4b the axis of radiation lies a little below the horizontal, while in the PL301, as shown in figure 4a, it lies above the horizontal. Except when the loudspeaker

4

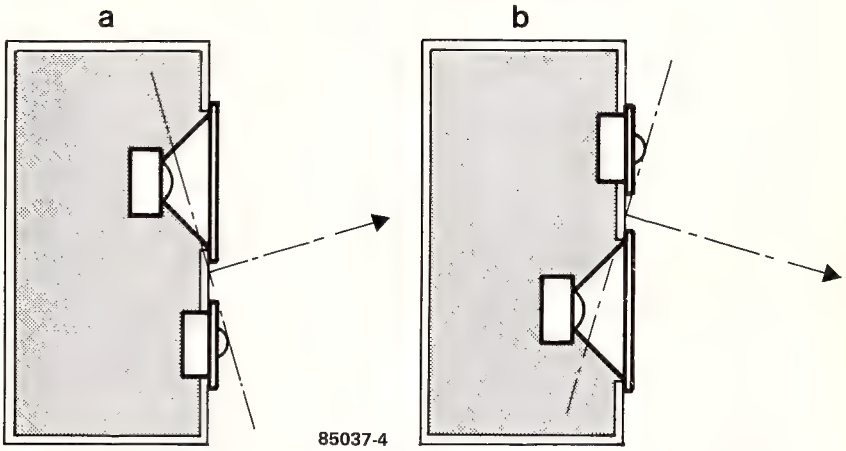


Figure 4. Axis of radiation with (a) middle frequency unit above the tweeter, and (b) the other way around.

5

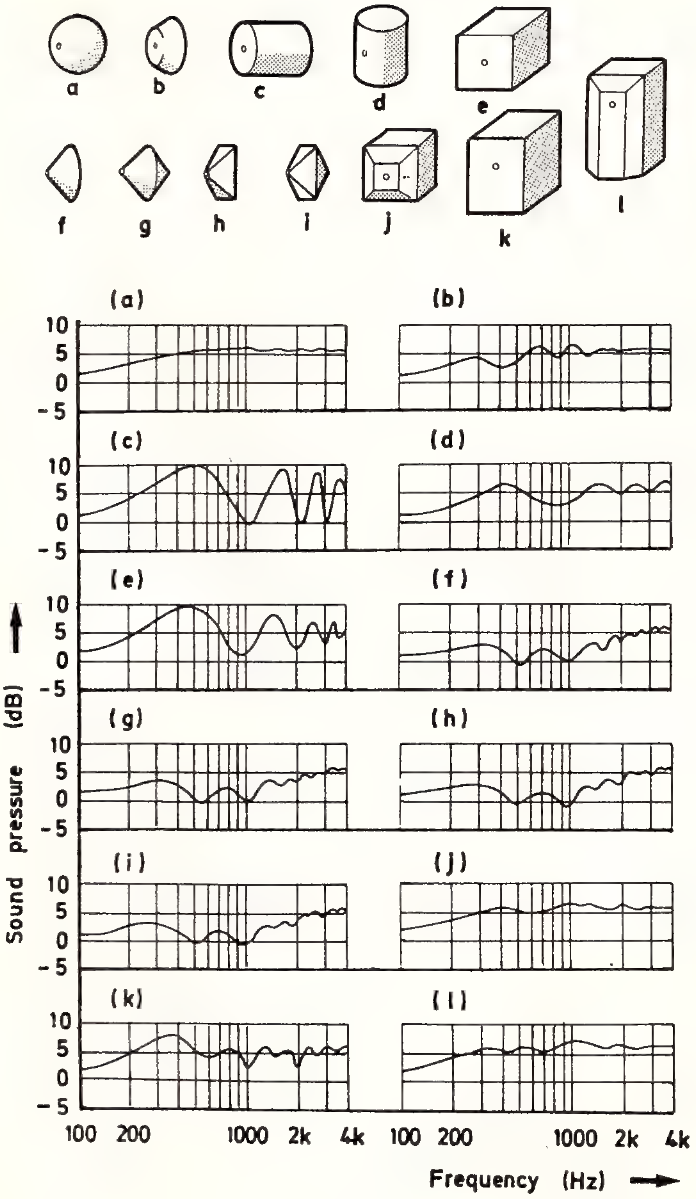


Figure 5. Various enclosure shapes and their characteristic frequency vs sound pressure curves.

6

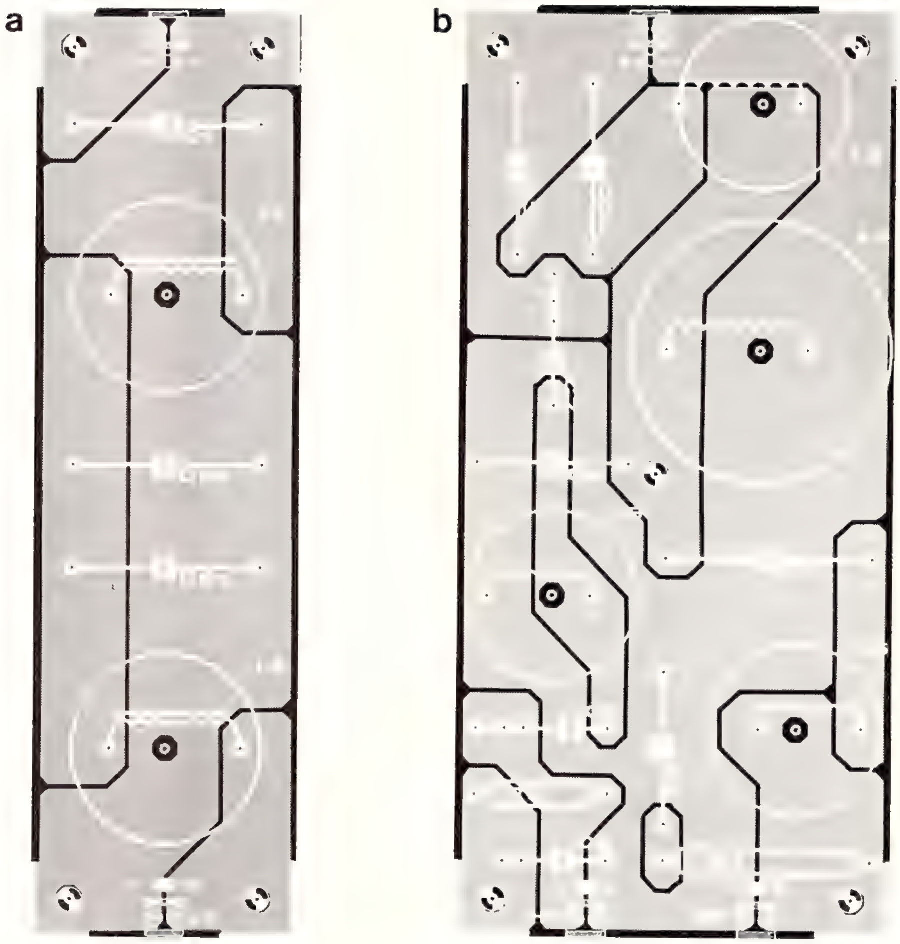


Figure 6. Printed circuit boards for the crossover network: (a) bass section; (b) middle and high frequency section. These PCBs are not available ready made.

Parts list

Drive units: KEF B300B (SP1071); KEF B100B (SP1057); KEF T52B (SP1072)
Dividing network: KEF DN28 or home construction according to figures 2 and 6
6 brass threaded rods M3 × 25 mm
24 nuts size M3
12 spade connectors size M3
2 terminal posts with top socket or a 2-way quick-connection lever terminal
About 2 metres of 1.5 mm² twin flex.
Timber: 22 mm plywood according to the sawing patterns in figure 8.
Sound-deadening material as required (available from motorists retail shops).
Roll of rock wool 30 mm thick.
Dr Bailey's longhair or fleece as required.
Good-quality wood glue
Screws or nails as required
Steel tensioning wire
6 dowels for grille
2 aluminium or steel tubes, 1030 mm long × 10 mm dia.
Grille cloth as required.
2 brass or steel bolts M6 × 20 mm and two wingnuts size M6 for fastening the middle and high frequency compartment.
Dry river sand as required
Four heavy duty castors, if required

Home constructed dividing network:

Resistors:
R_1 = 4.7 (5) Ω/10 watts
R_2 = 22 (20) Ω/5 watts

Capacitors:
(all bipolar electrolytic, min. 50 V working, but see text in regard of C7 . . . C9)
C_1 = 600 μF
C_2 = 60 μF (47 μF + 12 μF)
C_3 = 30 μF (2 × 15 μF)
C_4 = 12 μF
C_5 = 80 or 82 μF
C_6 = 20 or 22 μF
C_7,C_8 = 5 μF
C_9 = 2.2 μF

Inductors:
L_1 = 9.5 mH, ferrite core: $R < 1.4\ \Omega$
L_2 = 2.0 mH, ferrite core: $R < 0.5\ \Omega$
L_3 = 0.65 mH
L_4 = 2.0 mH air-cored, wire diameter 1 mm
L_5 = 0.3 mH
L_6 = 0.25 mH, air-cored, wire diameter 0.5 mm

Miscellaneous:
5 two-way moulded terminal blocks, 5 A

is at ceiling level, upward radiation is, on the whole, better than downward, because it is along a more direct line to the listening position, so that the detrimental effects of damping by floor covering, particularly carpets, are prevented. It should be mentioned here that in practice the direction of radiation deviates from that shown in figure 4 because of the effects of the phase shift caused by the crossover network.

Another noteworthy feature of the PL301 is that the upper compartment is displaced forward with respect to the bass chamber. This shift of about 450 mm may, dependent on the listening position, be reduced slightly. The forward shift permits the design of the crossover network to be optimized. The necessary phase equalization for inter-unit time delay is incorporated in the crossover design.

The interchanging of the middle and high frequency loudspeakers is closely associated with the shape of the cabinet. Most acoustic engineers are agreed that the shape of the enclosure has a vital bearing on the reproduction. Figure 5 correlates twelve differently shaped cabinets and the associated frequency response characteristics; it is derived from the well-known standard work *Acoustical Engineering* by W H Olson. Spherical shape a is clearly the ideal, but practical spheroids j and l are a good second and third; particularly shape j is hardly inferior to the spherical shape. Noteworthy is that conoids f. . . i score badly, whereas old faithful shape k comes out quite well.

The PL301 uses enclosure shape l, although the forward placing of the upper compartment makes the middle frequency characteristic approach that of shape j very closely. The partly slanting shape of the j and l variants is, therefore, the most conspicuous aspect of the PL301. That shape is continued in the front grille. From a practical point of view, this is an ideally shaped cabinet which has only one disadvantage: you need to be pretty good at woodworking to make it.

Construction

Note: these PCBs are not available ready made.

Starting with the dividing network, it seemed sensible to split the PCB, like the cabinet, into two parts: that for the bass section is shown in figure 6a, and that for the middle and high frequencies in 6b. The inputs of the two board are simply connected in parallel. Although building the PCBs is a fairly simple job, it is essential that you stick to the stated component values! Inductors L_1 and L_2 use ferrite cores, but all others are air-cored. The wire diameter for L_3, L_4, and L_5 should be 1 mm, and that for L_6, 0.5 mm.

The capacitors, with the exception of C_9 and possibly C_7 and C_8 (see *crossover network* above) are bipolar electrolytic types. Because values of 60 μF and 30 μF are not always easily available, the board has been designed to accommodate parallel combinations for C_2 and C_3. Normal

7

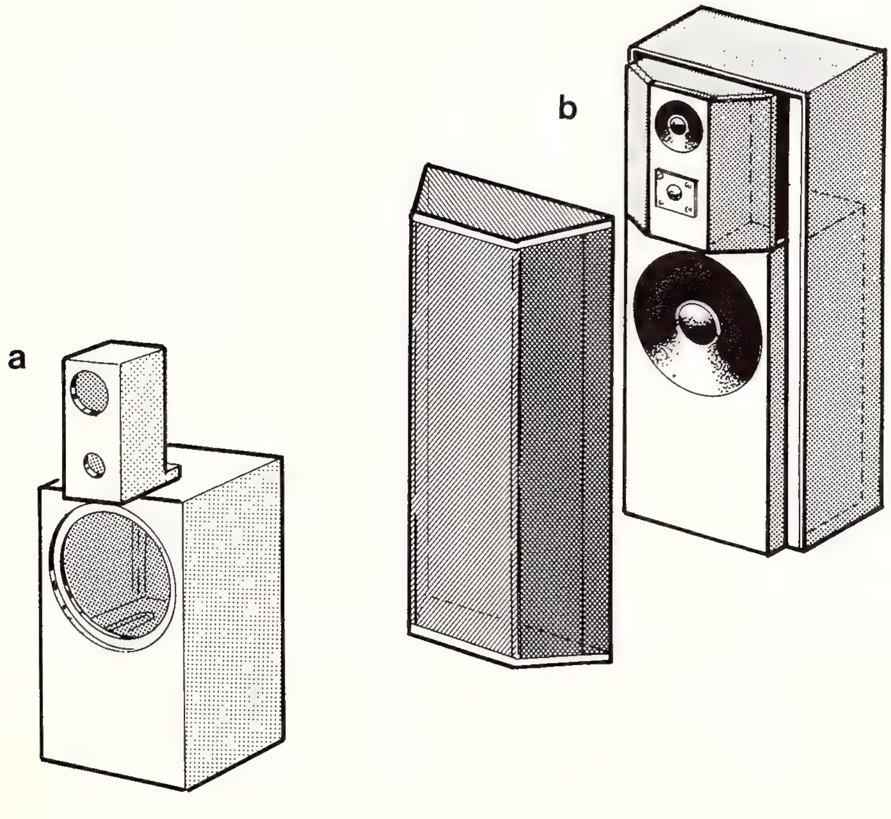
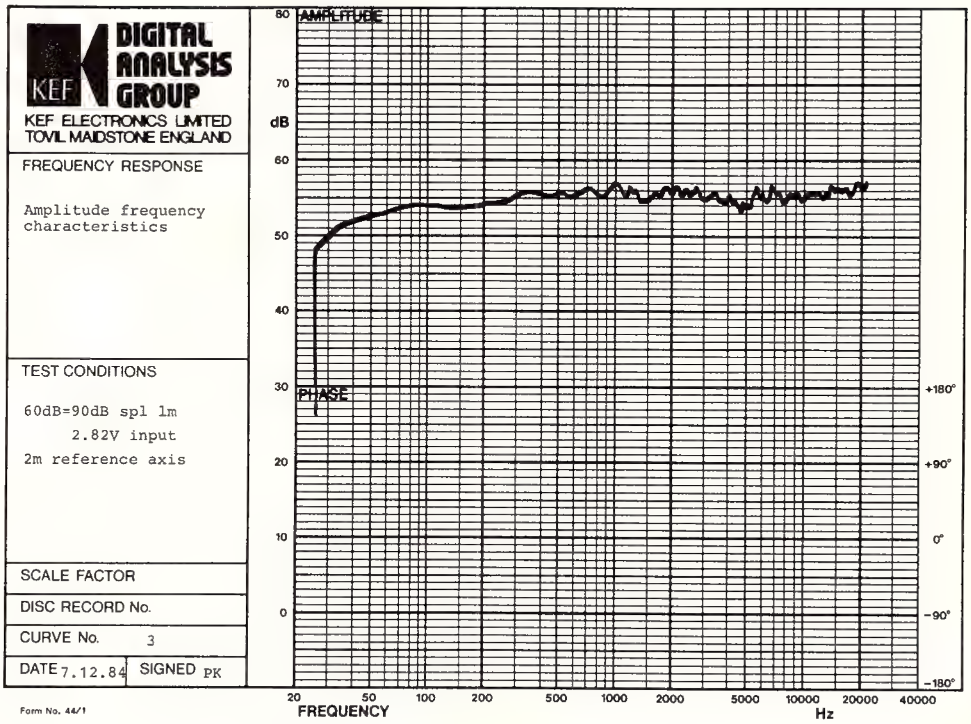


Figure 7. Artist's impression of the enclosure.

8



FREQUENCY RESPONSE

Amplitude frequency characteristics

TEST CONDITIONS

60dB=90dB spl 1m
2.82V input
2m reference axis

SCALE FACTOR

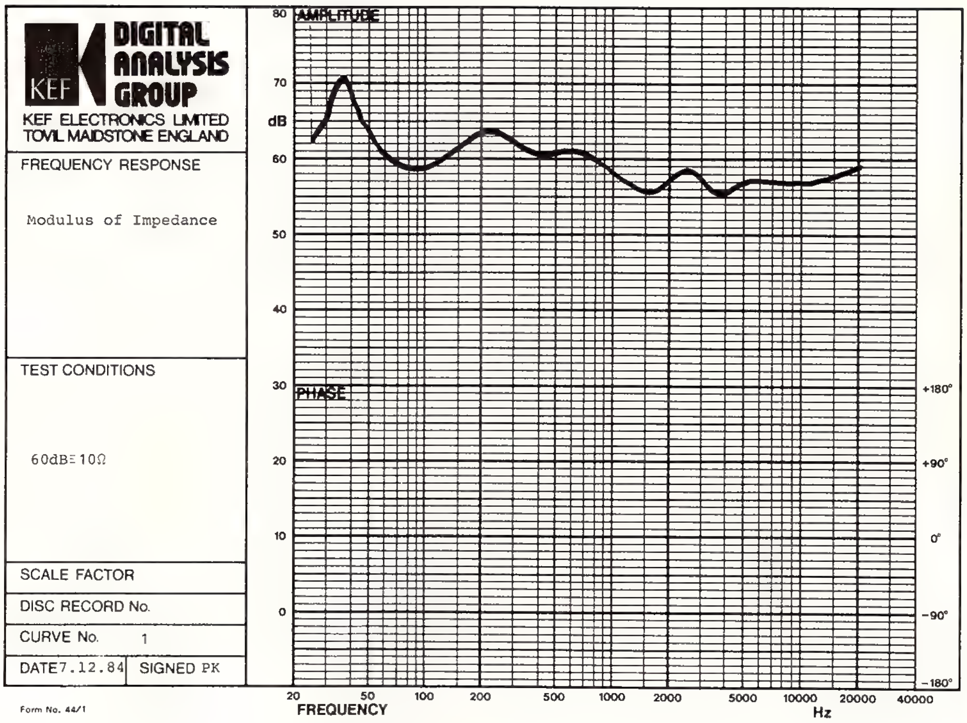
DISC RECORD No.

CURVE No. 3

DATE 7.12.84 SIGNED PK

Figure 8. Amplitude vs frequency characteristic.

9



FREQUENCY RESPONSE

Modulus of Impedance

TEST CONDITIONS

60dB≡10Ω

SCALE FACTOR

DISC RECORD No.

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Figure 9. Modulus of impedance vs frequency characteristic.

1.5 mm² flex may be used for the (fairly short) connections between the boards and the inputs sockets and between the boards and the drive units.

We have already touched briefly on the enclosure proper, and figure 7 illustrates how it consists, as it were, of an inner and outer cabinet. Figure 7a shows the basis, comprising the bass chamber with the compartment for the middle and high frequency units mounted on top. The bottom of the smaller compartment has been extended to the back and provided with sunken holes to enable the box to be fastened to the bass compartment with a couple of heavy bolts and wingnuts. Figure 7b shows what the construction looks like when the slanting side panels of the middle and high frequency chamber and the outer enclosure have been added.

The spaces between the side panels of the bass chamber and the outer enclosure are filled with sand. There is sufficient space left behind the upper compartment to accommodate not only the crossover network, but also a power amplifier.

The three drive units are sunk into the front panels. This does not require any milling or chiselling, because we have used a sandwich construction of two separate sheets of plywood that are glued together. The foremost sheet has a cut-out

(continued on page 47)

10

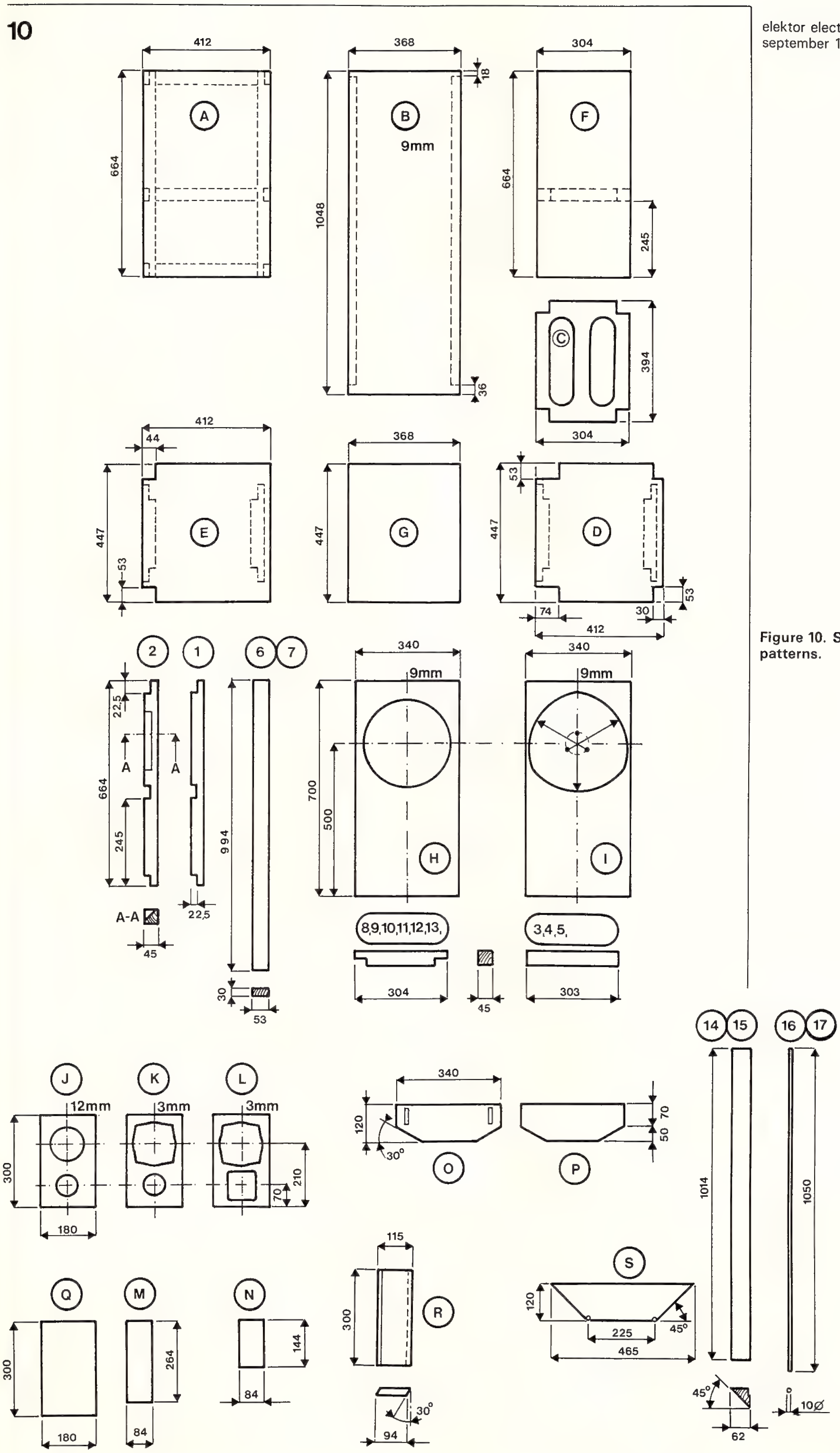
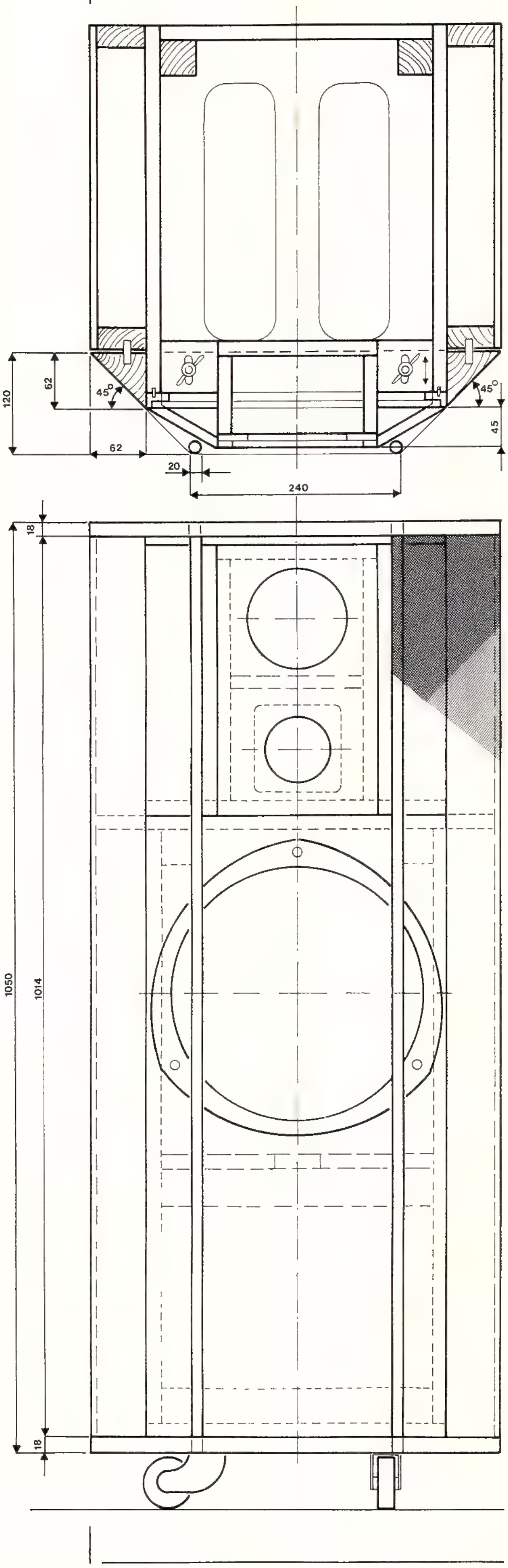


Figure 10. Sawing patterns.

11a



Constructional details

The bass chamber

- Fit battens 1. . .5, and then 6 and 7, to side panels A and A'. Next, fix panels B and B' to the side panels.
- Fit anti-boom panels to the inside of those parts of B and B' that protrude above the bass compartment. This is best done with floor covering adhesive.
- Mount partition C between side panels A and A'.
- Glue batten 12 to rear panel F and then fasten this panel in place.
- Glue battens 8 and 9 to lid D of the bass compartment.
- Glue battens 10 and 11 to floor panel E of the bass compartment.
- Fit floor panel E and lid D to side panels A and A'.
- Fit anti-boom panels to the inside of panel G and then fasten this top lid to panels A-B and A'-B'.
- Cut holes as indicated in panels H and I and then glue these panels together securely.
- Fit centre batten 13 between battens 2 and 2' at the front.
- Make all electrical connections to the bass drive unit.
- Fit 30 mm thick sheets of rock-wool to the inside of all panels and then fill the space behind the woofer loosely with Dr Bailey's longhair or fleece.
- Mount front panel H-I in place.
- Fill the space between panels A and B and that between A' and B' with (dry!) sand.
- Mount the bass drive unit in place with nuts, bolts, and washers.
- Finish the compartment as required with varnish, veneer, and so on.

Middle and high frequency compartment

- The front panel consists of J, K, and L; cut holes as indicated, and glue the three sections firmly together.
- Fit sides M and M' to the front panel, and at the same time fix partition N.
- Glue lower panel O and lid P to the compartment, and then fix back panel Q.
- Fit slanting panels R and R' at the front.
- Make all electrical connections to the two speakers.
- Fit the drive units in the compartment.
- Fill the compartment loosely with Dr Bailey's longhair or fleece.
- Finish the compartment as required (varnish, veneer, and so on).
- Screw the compartment to the bass unit.

Grille

- Drill holes in the top and bottom of the grille, i.e., panels S and S', for the cloth tensioning bars.
- Assemble panels S and S', together with battens 14 and 15 and cloth tensioning bars 16 and 17.

corrections

floppy centring unit (080)

(July&August 1985, p. 82)

In the article it is erroneously stated that "all existing connection remain". This is, however, not entirely true, as the old $\overline{\text{MOTOR ON}}$ to GND connection must be removed.

direct reading digitizer (054)

(July&August 1985, p. 60)

The article does not mention that, with the input open, P_1 should be adjusted to give an output of 000, while P_2 should be adjusted to give 900 at the output when the input is 900 mV.

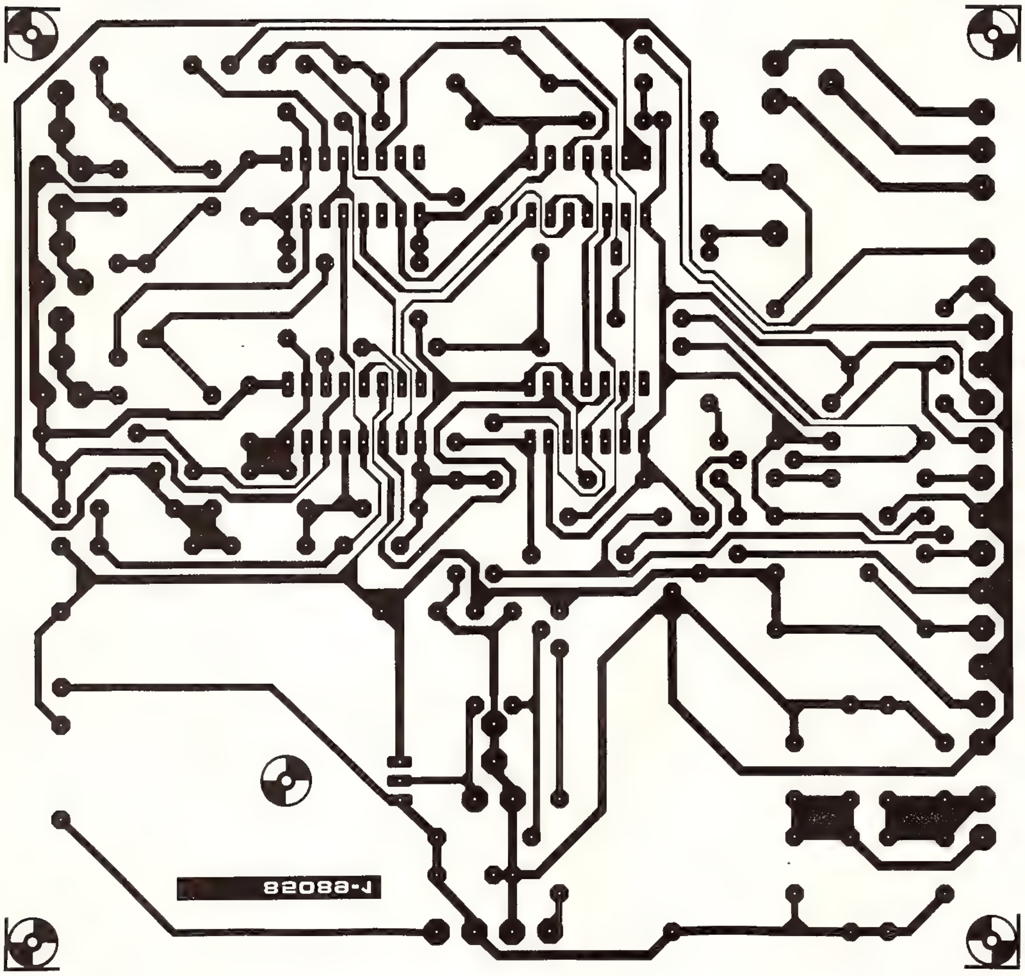
make your own PCBs

DANGER! Ultra-violet light is harmful to your eyes, so when working with a mercury vapour lamp, wear some form of *effective* eye protection.

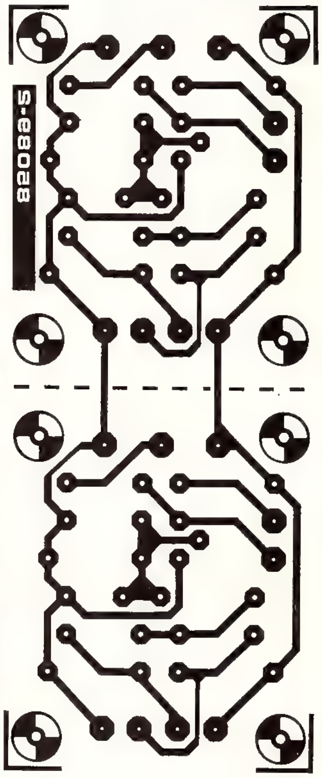
You require an aerosol of 'ISOdraft' transparentizer (distributors for the UK: Cannon & Wrin, 68 High St., Chislehurst, Kent, 01 467 0935, who will supply the name and address of your local stockist on request), a mercury vapour lamp, sodium hydroxide (caustic soda), ferric chloride, positive photo-sensitive board material (which can be either bought or home made by applying a film of photo-copying lacquer to normal board material).

- Wet the photo-sensitive (track) side of the board thoroughly with the transparant spray.
- Lay the layout cut from the relevant page of this magazine with its printed side onto the wet board. Remove any air bubbles by carefully 'ironing' the cut-out with some tissue paper.
- The whole can now be exposed to ultra-violet light.
- The exposure time is dependent upon the ultra-violet lamp used, the distance of the lamp from the board, and the photo-sensitive board. If you use a 300 watt UV lamp at a distance of about 40 cm from the board and a sheet of perspex, an exposure time of 4...8 minutes should normally be sufficient.
- After exposure, remove the layout sheet (which can be used again), and rinse the board thoroughly under running water.
- After the photo-sensitive film has been developed in a sodium hydroxide solution (about 9 grammes of caustic soda to one litre of water) for no more than 2½...3 mins at 20°C, the board can be etched in ferric chloride (500 grammes of $FeCl_3$ to one litre of water). Then rinse the board (and your hands!) thoroughly under running water. It is advisable to wear rubber or plastic gloves when working with caustic soda or ferric chloride solutions.
- Remove the photo-sensitive film from the copper tracks with wire wool and drill the holes.

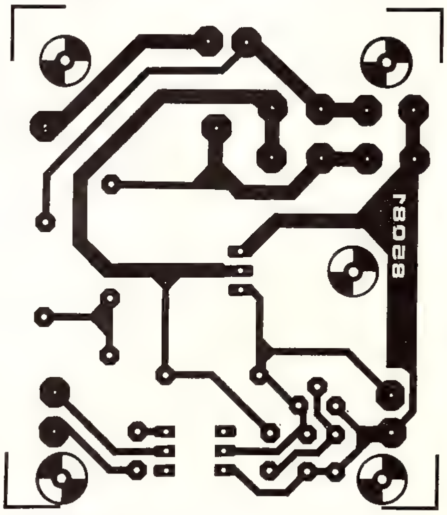
intruder alarm



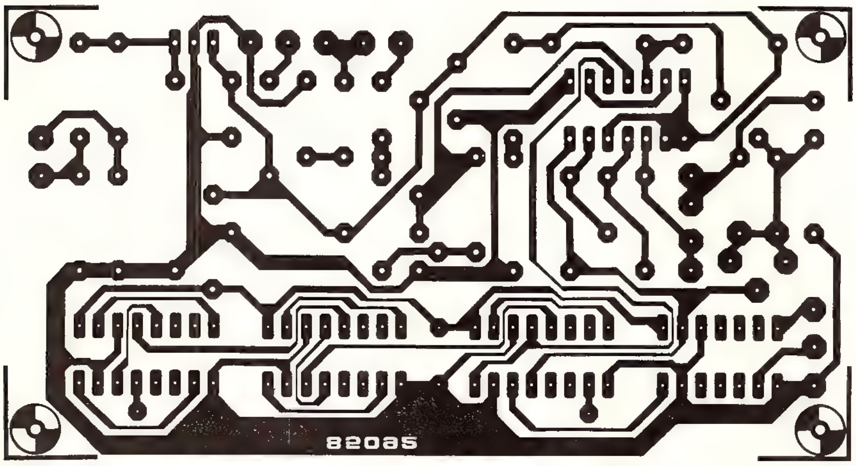
intruder alarm



solid-state relay

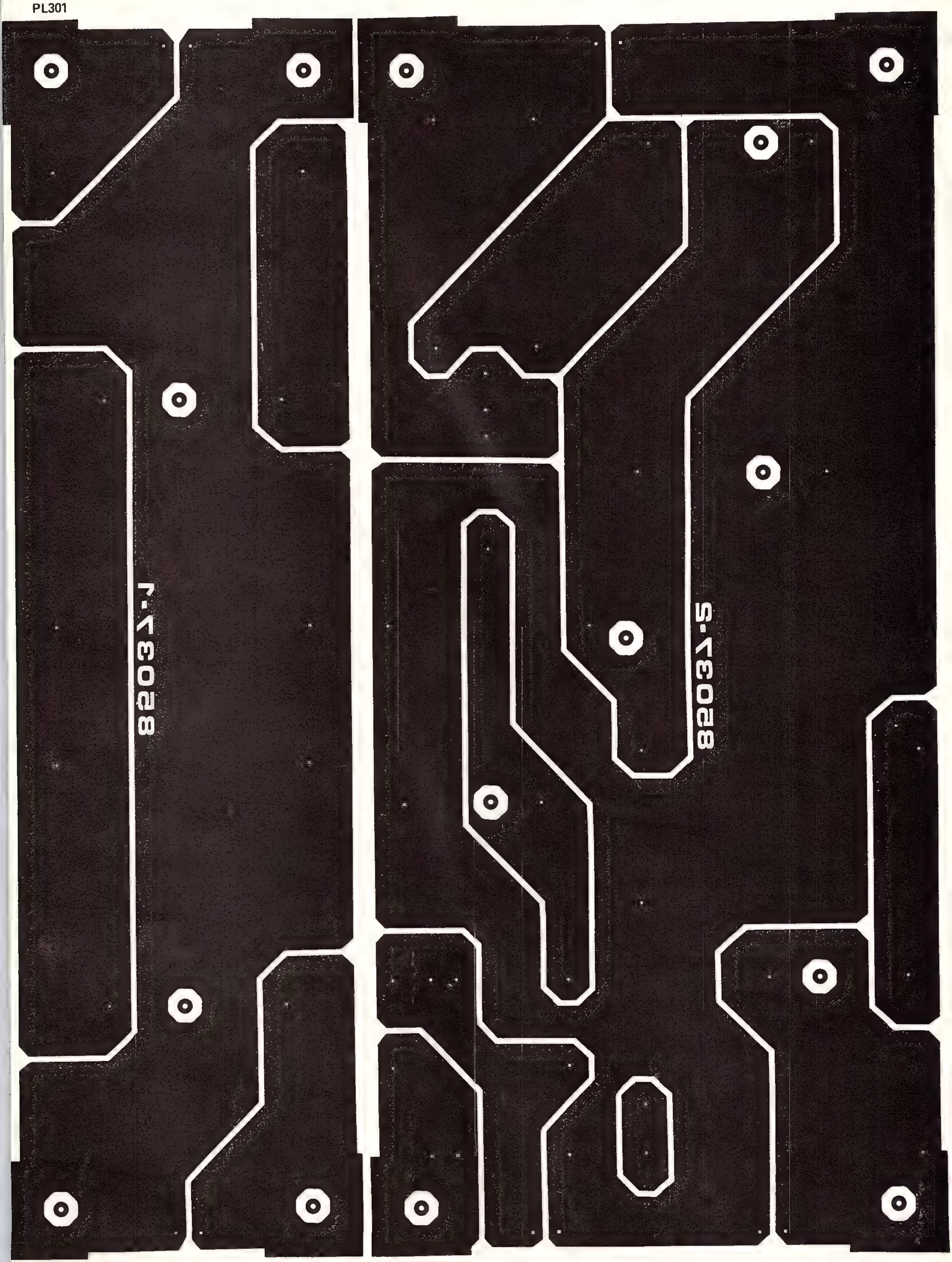


frequency standard



Apology: owing to lack of space, it was not possible to include the drawings for the RS232 interface board; if at all possible, this will be included next month.

PL301



11b

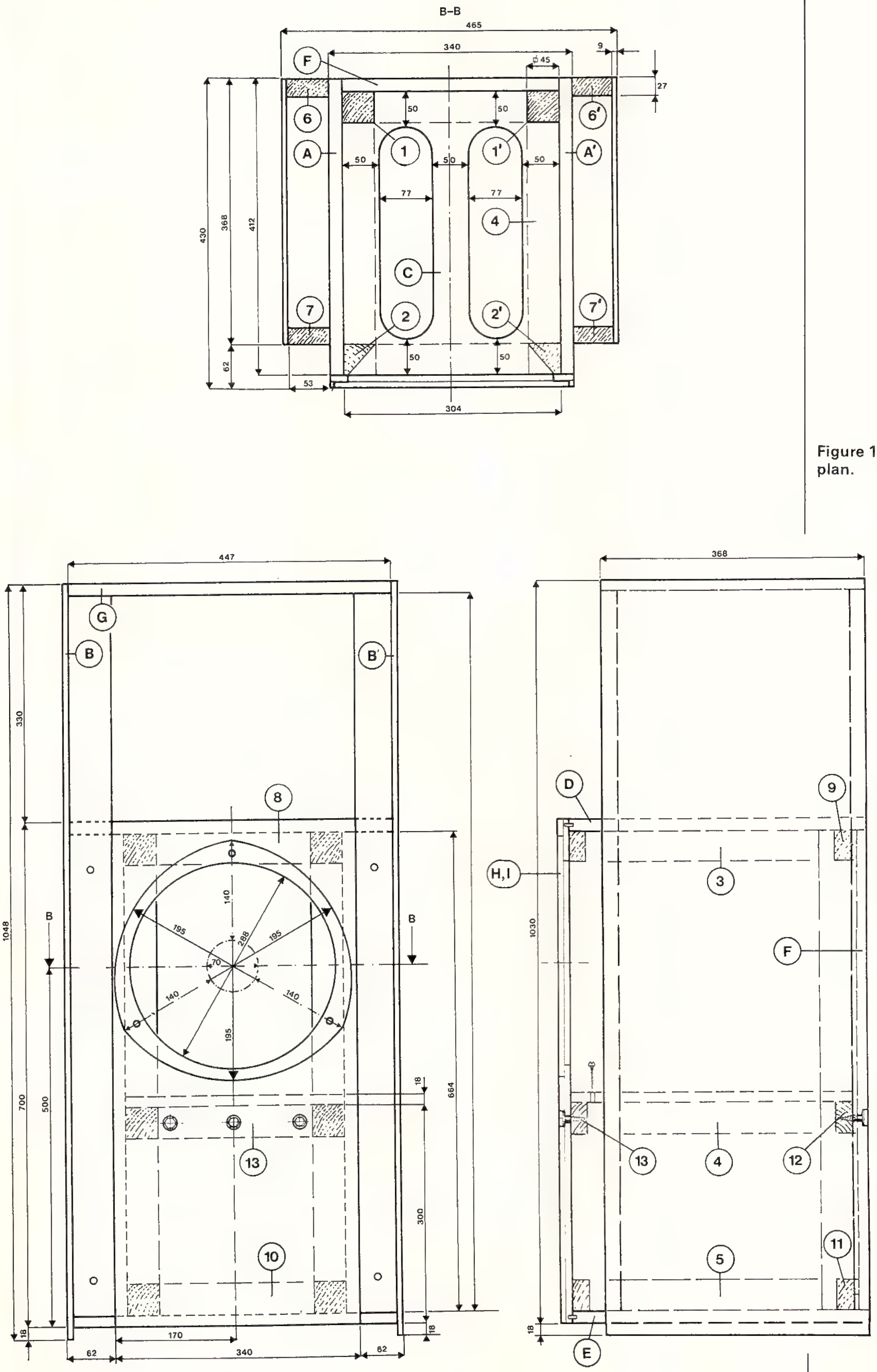
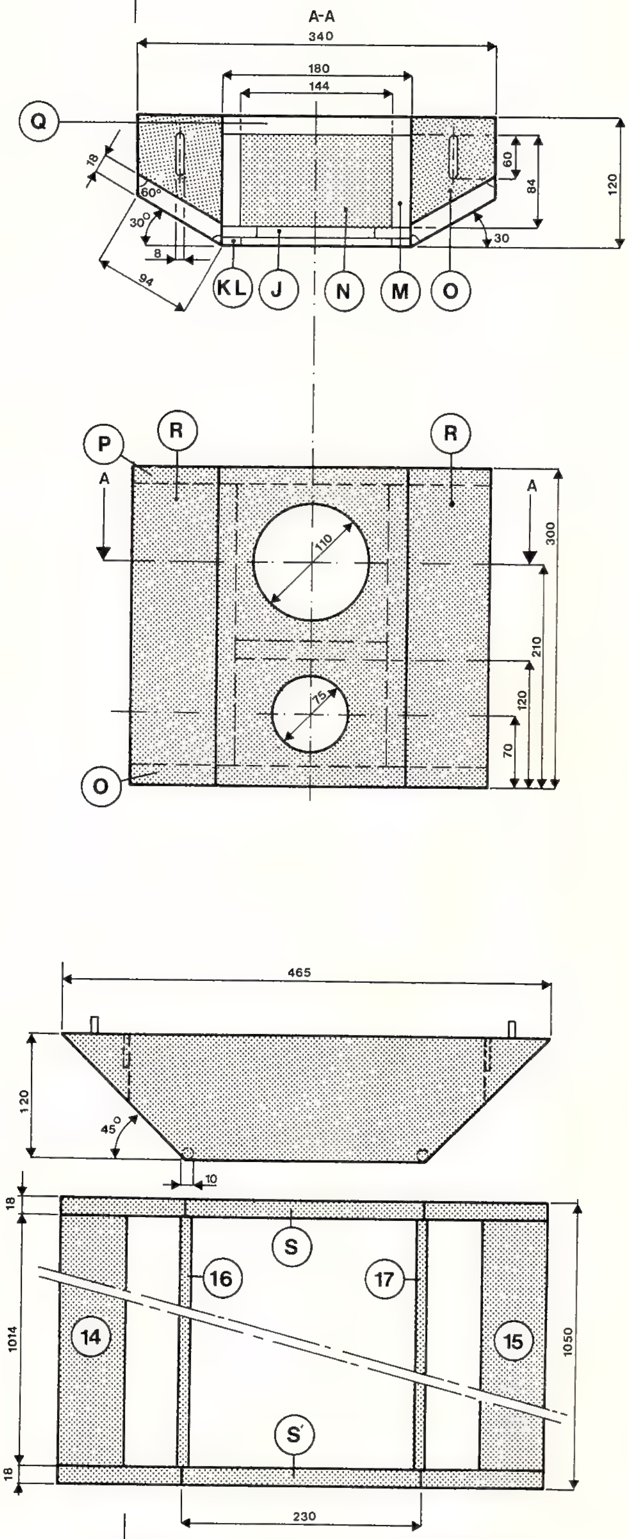


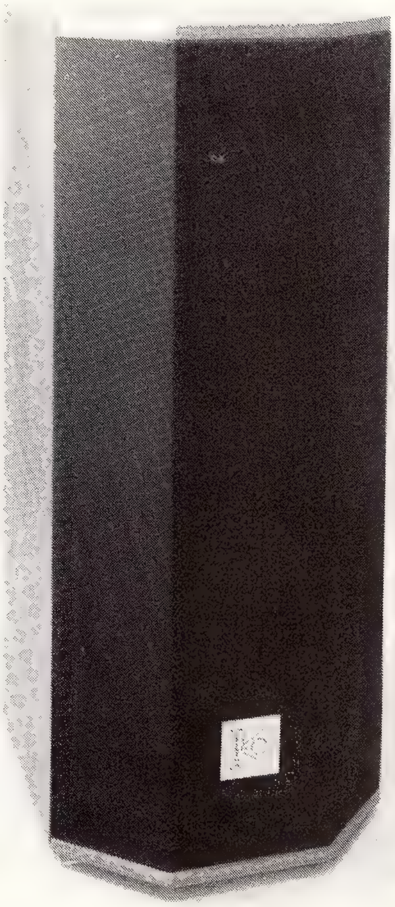
Figure 11. Construction plan.

11c



85037

- Finish the grille as required (varnish, veneer, and so on).
- Fit dowels in the side battens — 14 and 15 — to enable the grille to be fastened to the enclosure.
- Fasten the grille cloth to the top and bottom of the grille with steel tensioning wires. The protruding edges of the cloth should be stapled to the back of the side battens.
- Fit the grille to the enclosure.



the same size as the outer diameter of the loudspeaker, while the second panel has a slightly smaller cut-out. KEF provides a paper template for cutting the holes for the drive units.

The complete cutting pattern of the enclosure with all dimensions is given in figure 10. It has been designed in a manner by which standard available sheets of wood are utilized as economically as possible. If your carpentry skills are suspect, it is wise to have the material sawn by an experienced carpenter to ensure that all parts are the right size and straight!

For the rest, you need a good quantity of first class wood glue and an assortment of screws and/or nails. Since this is in any case a project for experienced handymen, we will not go into details as to what types and sizes of screws and/or nails, or, indeed, whether you screw or nail the cabinet together. As long as all panels are fastened together securely, and the cabinet is airtight on completion, it does not matter how you do it.

The construction plan is given in figure 11: a shows the complete enclosure with outside dimensions, b shows the bass chamber complete with outer enclosure, and c gives all the details of the middle and high frequency speakers compartment complete with grille. Construction can thus be sub-divided into three different phases, detailed on pages 39, 40 and 45, 46, which can conveniently be lifted out if desired.

Finally

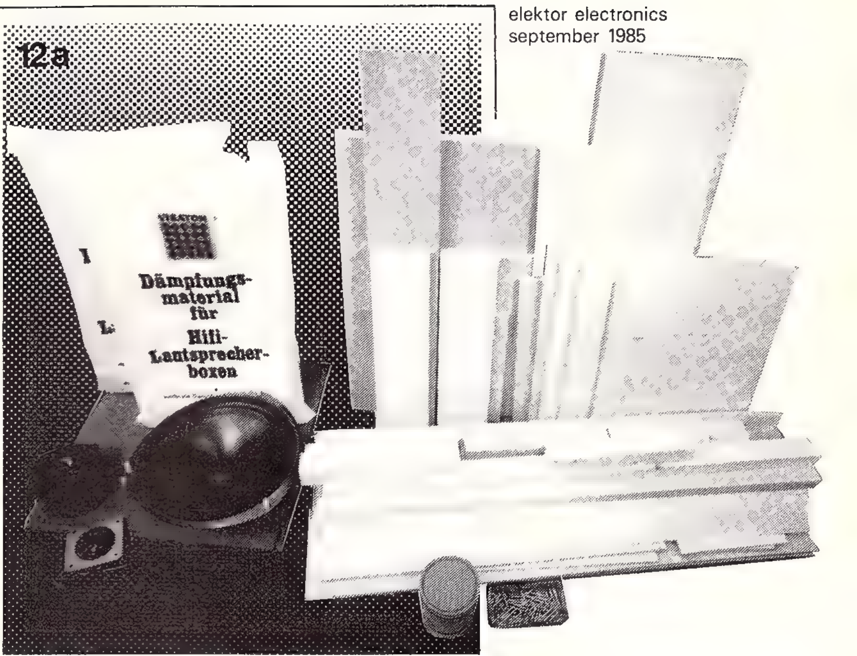
As stated before, the crossover network may be housed in the empty space behind the middle and high frequency compartment.

The various interconnecting wires can be taken through the (back) panels via 3 mm diameter brass threaded rods and heavy-duty spade terminals.

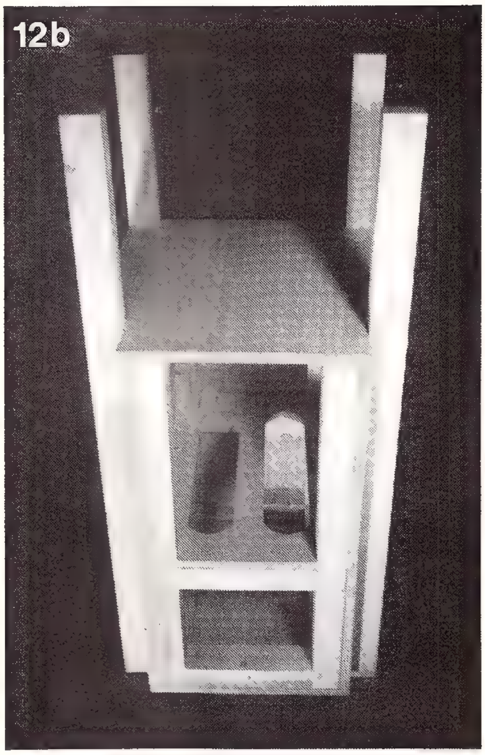
The photographs in figure 12 show various stages of the construction.

Impedance and frequency curves are given in figures 9 and 8 respectively, while the technical characteristics are summarized in table 1.

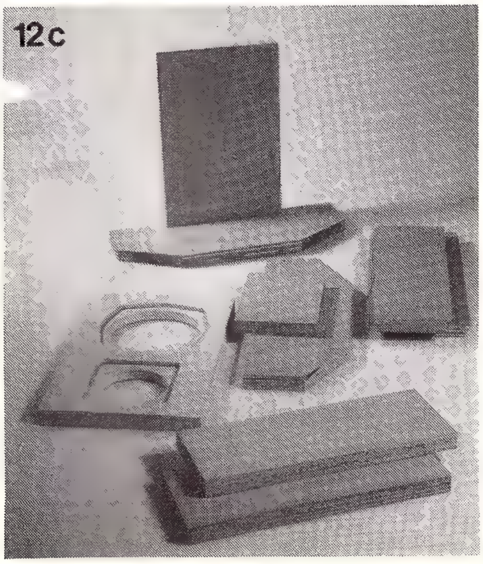
12a



12b



12c



12d

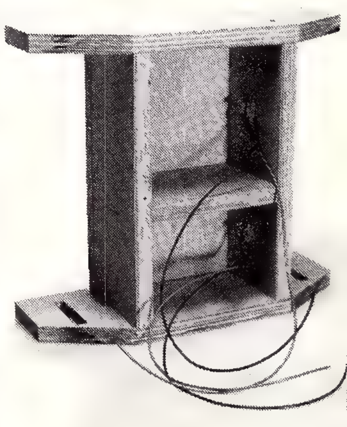


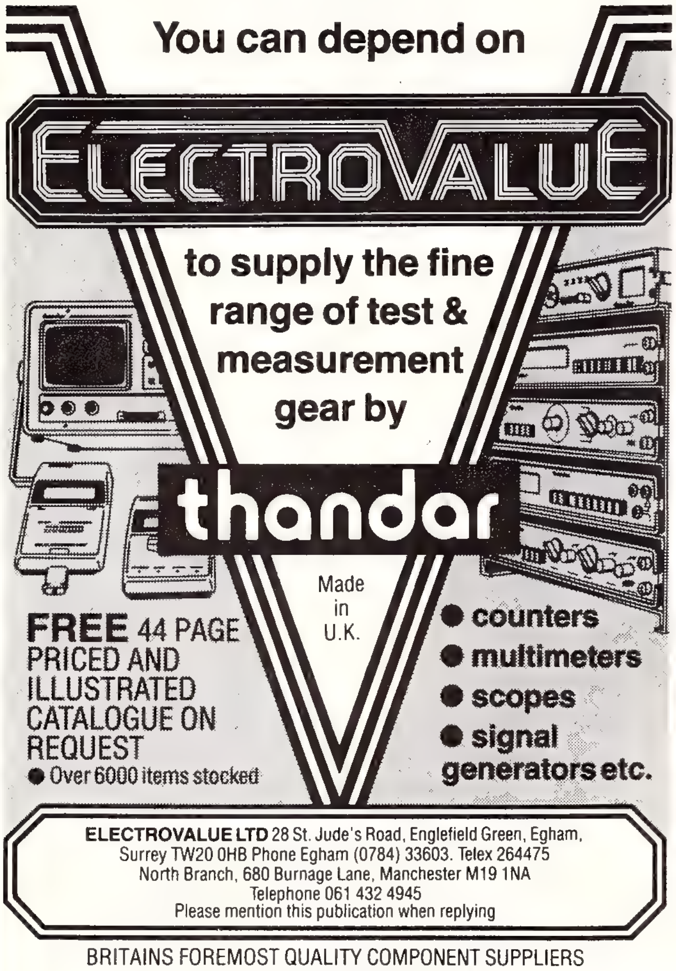
Figure 12. Photographs of various stages in the construction.

12e

12f

12g

12h



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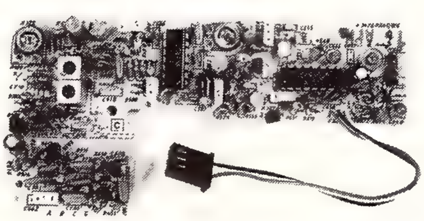

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One of the most common sales ploys in the computer world is to demonstrate a machine's capability for graphics. Unfortunately, the graphics card is often an optional extra or so basic that it needs very powerful programs to control it. In general, it is far better to use a separate graphics card. The one described in this series of articles offers a range of options rarely found together in one project. It is very efficient due to the clever balance of software and hardware: a balance achieved only after many months of design and tests. The major characteristics of both the hardware and the software are summarized in Table 1.

1

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P Lavigne &
D Meyer

Basically, a graphics card is an autonomous terminal that generates graphic video images based on instructions received and decoded by the software. In a sense, it is similar to a printer receiving ASCII codes and converting these into control signals for driving its print head. The difference between a printer or *x-y* plotter and a graphics card is that the latter does not need a separate CPU to interpret the instructions, since it makes use of the host system's microprocessor. The processor on the graphics card is used to generate the screen memory and to make traces.

ASCII is the acronym for American Standard Code for Information Interchange; it is a 7-bit code that gives 128 unique combinations or characters, of which 32 are reserved for special control functions.

Design considerations

A graphics card has a number of advantages over a VDU card: it provides dot-by-dot (rather than block-by-block) graphics; its results have a high resolution; and it can support colour. In addition, a graphics card enables text to be included in the picture, so that, with the associated software, it is also an alphanumeric video terminal with a resolution of 32 lines of 80 columns. This latter property is more important than may appear at first sight, since it enables both the colour and the size of the characters to be easily changed, to the obvious benefit of versatility.

pixel is short for picture element; it is also called a pel or a dot

All pixels on the screen are accessible on an *x-y* matrix when the coordinates are presented to the graphics processor. The origin, $x=0$; $y=0$, is found at the top left-hand corner in text mode and at the bottom left of the graphics screen.

The complete card, with colour extension, uses only 19 addresses in the host's memory. This makes it simple to include the card in any system, particularly a

Table 1.

HARDWARE

Processor:	GDP9366 (9365) or GDP9367
Databus:	8-bit, buffered
Addresses decoded:	19 (XX50...XX5F, XX64...XX66). The screen memory is autonomous with automatic refresh (16K per page and per colour)
Synchronization:	composite, normal or inverted (buffered TTL output)
Video:	monochrome, RGB or RGBI (buffered TTL outputs)
Lightpen:	negative pulse (buffered TTL input)
Resolution:	4 pages of 512×256 pixels (9366/9367) 2 pages of 512×512 pixels (interlaced only/9367)
Colours:	monochrome on the main board RGB on the extension } 8 or 16 colours **Note:** The number of colours does not restrict the resolution in any way. Several extension cards may be added.
Scrolling:	vertical scroll (the software changes the display addresses sent by the GDP to the video memory)
RWM:	read/modify/write mode (EXOR gate between pen and paper)
Communication with the screen memory:	pixel-by-pixel reading (the microprocessor uses a special instruction to feed the pixel coordinates into the GDP)
Interrupts:	IRQ (3 programmable modes)
Generators:	■ alphanumeric characters (on a 5×8 matrix). The number of characters is individually programmable for *x* and *y* axes. ■ programmable vectors (four types of trace) — see software

SOFTWARE

The graphics card is supplied complete with software (a little less than 4K of 6502 object code). This is sub-divided into two programs, one of which generates all the **text** (and is a sort of ASCII video terminal) and the other handles all the **graphics**. The software is completely autonomous and acts almost like a super reception routine for the contents of the accumulator. Note how concise the instructions are.

Table 1. Technical characteristics of the graphics card.

6502-based one, since the control interpreter was designed around this processor. The software can, of course, be changed to suit a different processor, or to enable the graphics card to be driven direct, but this involves some more work, which will be considered at a later stage. The colour extension and mother boards are both of eurocard format. The latter is completely independent and monochrome; its input is linked to the microprocessor bus, while the output provides the video signals that are fed direct to a monitor. Apart from the graphics processor and TTL circuitry, this card contains 64 K of dynamic RAM.

The colour card, which will be discussed later, has four banks of 64 K memory that form an extension mounted parallel to the mother board. This card communicates with the host's microprocessor via its data bus, and with the mother board by a separate bus. It provides RGB (red, green, blue) signals that are combined with the base board's video signal to obtain 2, 4, 8, or 16 colours (or shades of grey) on a monitor with RGB or RGBI (I = intensity) inputs. It is possible to add a second extension card (for which provision has been made) and generate, 32, 64, or 128 colours.

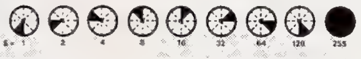
Functional diagram

The basic functional diagram is given in Figure 1a; that in the Figure 1b is complete with the colour extension card. The graphics card is based on the Thomson Type EF9365, EF9366, or EF9367 **graphics display processor (GDP)**. The processor generates 64 K of dynamic video RAM, which is completely separate from the memory of the computer with which the graphics card is used. The timing and clock stages control the timing of the internal signals and are in turn driven by the dot clock, which is either a 12 MHz or 14 MHz version.

The graphics card can access the microprocessor data bus either via the GDP or via the read/write latch. An internal address decoding circuit handles all communications and the graphics card, therefore, needs only nineteen addresses from the host system.

Table 1

CHR$	Text mode commands
(1)	Transfer video buffer contents to screen
(2)	Open the video buffer
(3)	Close the video buffer
(4)	Use graphic commands in text mode
(5)	
(6)	
(7)	
(8)	Backspace (cursor left)
(9)	Horizontal tabulation (cursor right)
(10)	Line Feed (cursor down)
(11)	Vertical tabulation (cursor up)
(12)	Clear screen&home cursor
(13)	Carriage Return
(14)	
(15)	
(16)	
(17)	Set text mode
(18)	Set graphic mode
(19)	
(20)	Reset the character size
(21)	
(22)	
(23)	
(24)	
(25)	
(26)	Erase current line
(27)	Escape
(28)	Home cursor
(29)	Clear to end of line
(30)	
(31)	

	Graphic mode commands
A	Set text mode
B n	Set background color to color "n"
B −n	Combine the background color with color "n"
C n	Set pen color to color "n"
C −n	Combine the pen color with color "n"
D x,y	Draw from current position to **x,y** destination
D x,y,x,y,...	D may be followed by several x,y destinations X,Y coordinates are given from absolute origin
E	
F	
G ±n,x,y	n=1: ; n=2: ; n=−1: ; n=−2
H	Home pen to current origin (without drawing)
I	Set current location as new absolute origin
J x,y	Draw from current pen location to **relative position x,y**
J x,y,x,y,...	J may be followed by several x,y destinations
K	
L n	Set line type n; n=0: ____; n=1: .....; n=2: ------; n=3: -.-.-.
M x,y	Move to absolute location **x,y** without drawing
N	
O s,r,t	Draw a circle or a disk with current absolute origin as center s = **sectors**; r = **radius**; t = **thickness** 
P characters	Print alphanumeric characters without leaving graphic mode
Q d	Set the print direction; d = 0: **horizontal;** d = 1: **vertical**
R x,y	Move to relative **x,y** position from current pen location (without drawing)
S x,y	Set character size x on X axis / y on Y axis
T t	Set character type t; t = 0: normal; t = 1: tilted
U p,u	Select pen/eraser up/down; p=1: pen; p =0: eraser; u=1: down; u=0: up
V x,y	Get pixel status in specified **x,y** location
W m	Set Read-Modify-Write mode; m=0: **no RMW mode**; m=1: **RMW**
X a,s,i	Draw a coordinate axis from current location in direction "**a**" using increments "**s**"(teps) (+ or −) and marking "**i**"(ntervals)
Z p	Select page "p"

Examples in BASIC:

```
PRINT CHR$(18) "M0,127,I"
PRINT "B6,C4,D255,127,255,0"
PRINT "C2,M127,63,I"
PRINT "0255,60,2"
etc...
```

Table 1 gives the instructions that are accepted by the command interpreter, which will be discussed later. These instructions are not directly intended for the GDP, which cannot interpret them either in the form given. Note that the majority of the instructions and their syntax are the same as those used with a number of plotters, such as, for instance, the Tandy.

Before the command interpreter can be dealt with, it is necessary to study the mother board, followed by the colour extension card.

1a

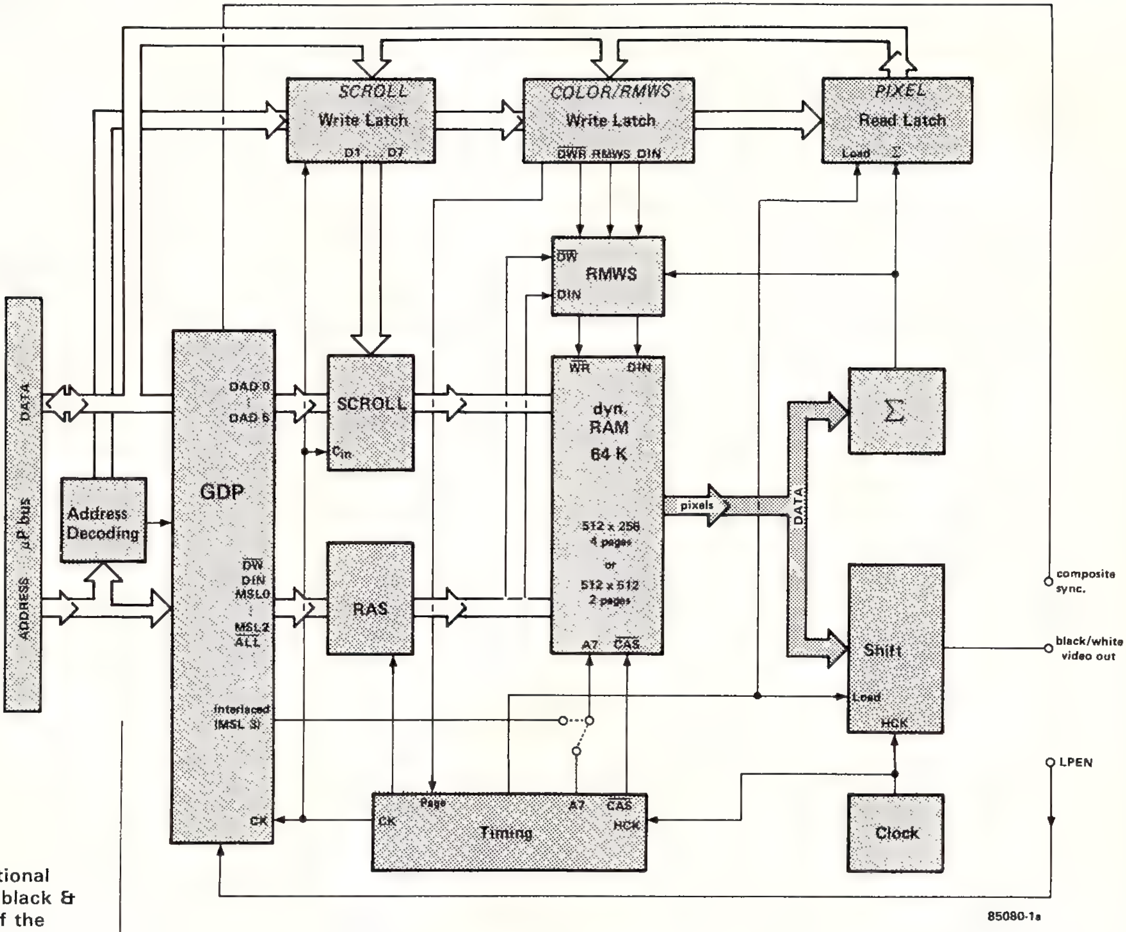


Figure 1a. Functional diagram of the black & white version of the graphics card.

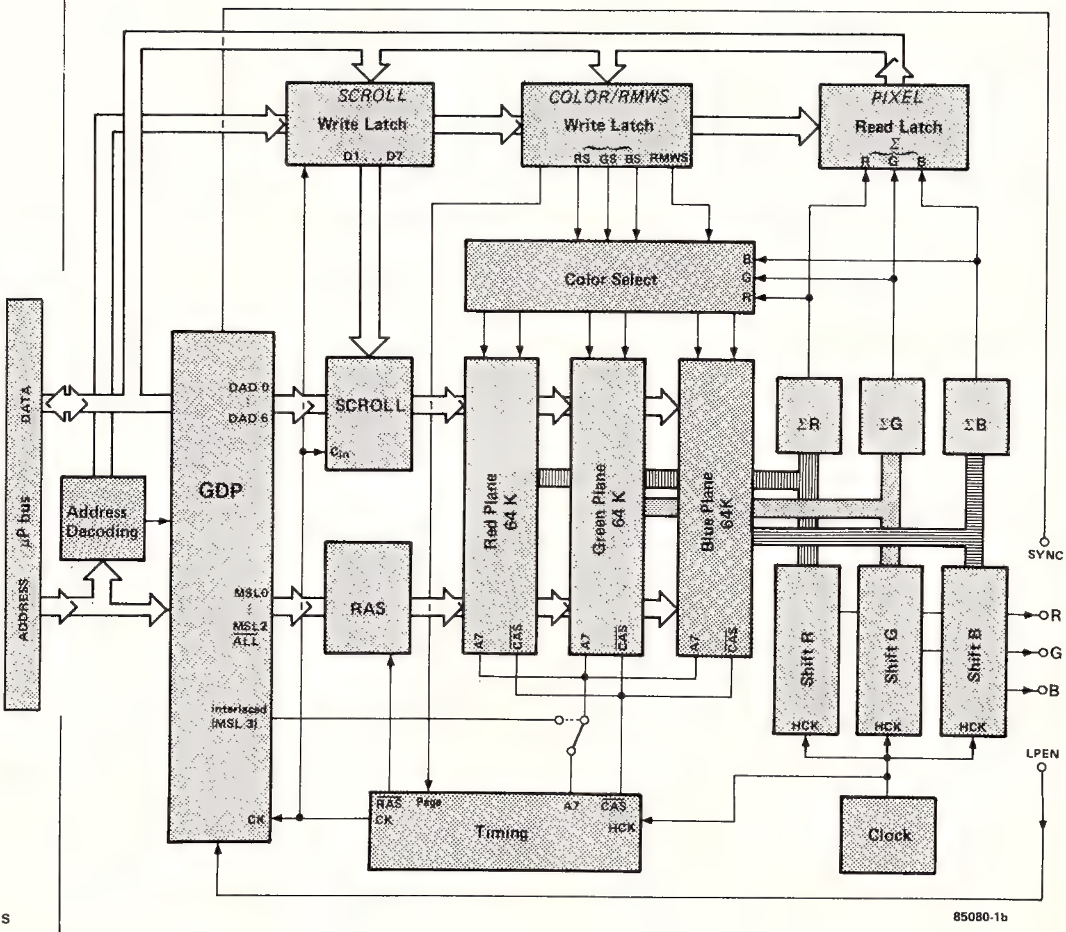


Figure 1b. Functional diagram of the colour version of the graphics card.

The ***SCROLL* register** enables the microprocessor to shift the addresses supplied by the GDP to the video memory in order to move the entire screen image vertically. This is particularly interesting when there is text on the screen.

The ***COLOUR* register** allows the colour of the pixels to be changed, and also permits the shift of the screen memory from the 512 x 256 (non-interlaced; four pages) mode to the 512 x 512 (interlaced; two pages) mode.

The ***RMWS* (read-modify-write select) register** enables the contents of the screen to be altered without the need of memorizing the original, which can, however, be recalled afterwards. This will be dealt with in more detail later.

The ***PIXEL* register** makes it possible for the microprocessor to examine the state of a pixel, the coordinates of which it has fed to the GDP. It is, of course, a read only latch.

The **second SCROLL** function (in association with the ***SCROLL* register**) alters the addresses sent by the GDP to the video memory so as to shift the entire image vertically.

The **RAS (row address strobe)** simply distinguishes between the two different access modes of the GDP to the video memory. In the first of these modes, eight ICs in the memory are accessed simultaneously to refresh or change the background colour or any other aspect of the addressed byte. In the other mode a single IC is accessed to read or write a single point, i.e., when only one bit of the relevant byte is addressed.

The complete functional diagram in Figure 1b includes the extension for 8 colours, which will be reverted to later.

Black & white picture production

The image on the fluorescent screen of the cathode-ray tube (CRT) in the monitor display unit comprises hundreds of thousands of pixels. The screen is scanned in both the horizontal and the vertical direction by an electron beam moving at a rate of 64 μs per line. The horizontal direction is termed the line, and the vertical direction, the field (also called the raster). Sawtooth waveforms are used to deflect the beam: the flyback period is blanked out.

Pulses are used to synchronize the original signal and the screen image. The line synchronizing pulses are generated during the line flyback period, and the field synchronizing pulses during the field flyback.

For optimum performance, the number of horizontal scans is made larger than the number of vertical scans. The number of lines traversed per second is the line frequency; the number of vertical scans per second is the field frequency.

2a

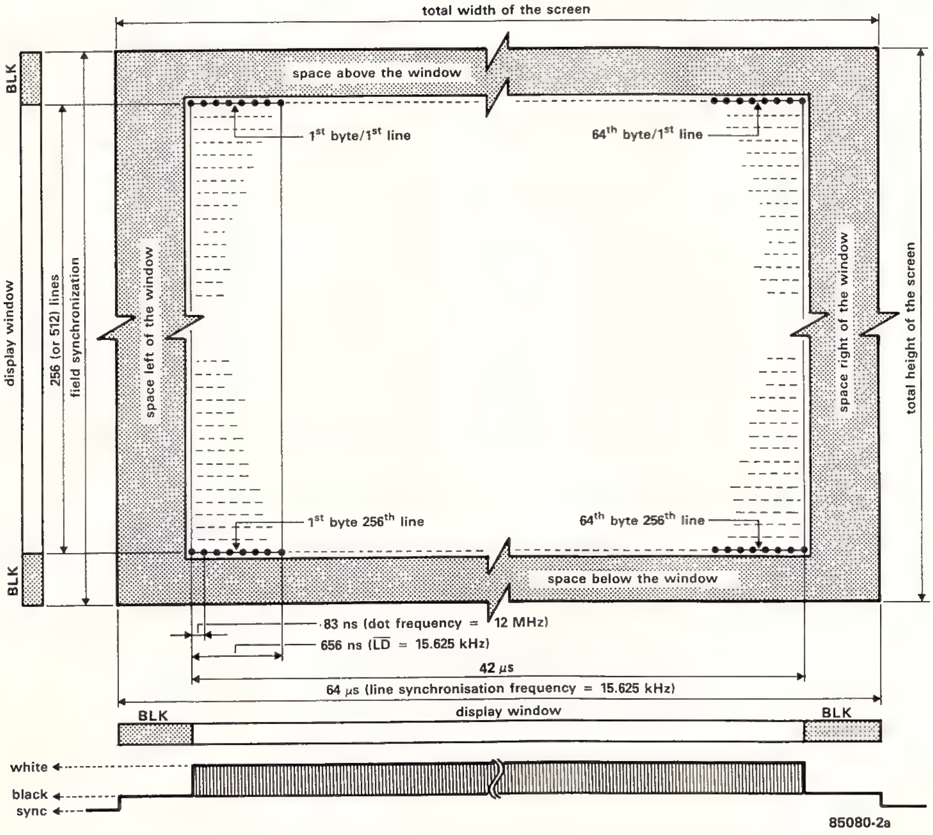


Figure 2a. Picture size and image production.

Generally, interlaced scanning is used, in which the lines of successive fields are not superimposed on each other, but are interlaced; two rasters form a complete picture or frame. The number of complete pictures per second is the frame frequency, which is, therefore, half the field frequency. The field frequency is slow enough to allow a great number of horizontal lines, and fast enough to eliminate flicker. European systems invariably use the 625 lines per frame standard recommended by the CCIR, and a field frequency of 50 Hz, whereas the system in North America uses a 60 Hz field frequency and 525 lines per frame.

A graphics card defines a rectangular window within the screen area as one in which lines are scanned in 42.667 μs (see Figure 2a). If each line contains 512 pixels, it is about 83 ns wide. A complete scanning line (from one edge of the screen to the other) then contains 768 pixels. This gives a pixel frequency of 12 MHz, which is applied as a clock to a shift register. If this is an 8-bit type, the bits are input at a frequency of 1.5 MHz.

At the start of a scanning line nothing happens until it reaches the left window frame: the shift register then loads the first byte and outputs one pixel every 83 ns (see Figure 2b). After 8 x 83 ns, the first eight bits at the top left-hand side of the screen are either on or off. The shift register then loads the second byte, and continues outputting bits. This goes on until it has output the last bit of the 64th byte for this line, when the line reaches the right-hand frame of the display window. Nothing happens then until the line sync(hronization) pulse, when the electron beam flies back to start scanning the next line. This process continues until the end of the last line at the bottom of the window has been reached. Note that the top and bottom of the screen fall outside the window.

Next, the field synchronizing pulse causes the electron beam to fly back to the point of origin at the top left-hand corner of the screen, and the whole process starts afresh.

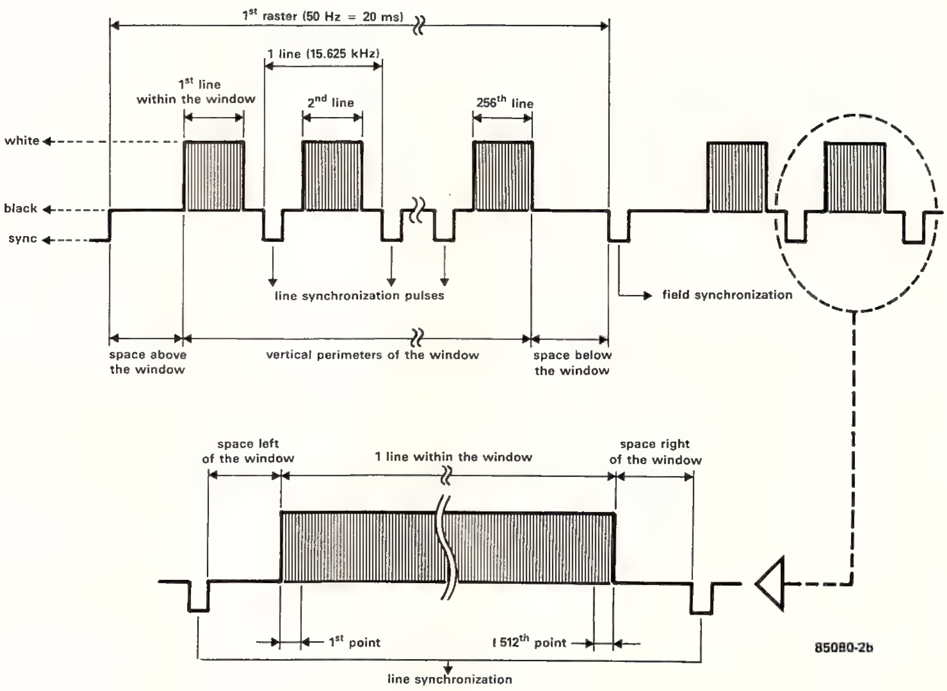
It is clear that there are three factors determining the picture: the sync pulses, which have fixed frequencies irrespective of the contents of the picture, and the video signal proper. The latter may be considered as composed of all the pulses corresponding to the dots making up the picture. It is derived from the dot clock, which provides the timing for the output shift register. This register receives information as to brightness of the pixel in packets of eight bits — the **luminance** signal — that are loaded simultaneously to the video memory. The pulse indicating "load the next byte" arrives while the previous eight bits are being read, provided the beam of electrons is within the window. A blanking signal ensures that the screen outside the window remains completely dark.

Colour pictures

The colour information is contained in the **chrominance** signal, which is obtained by combining three binary signals, each of which represents one of the primary

Figure 2b. Composition of the video signal.

2b



3

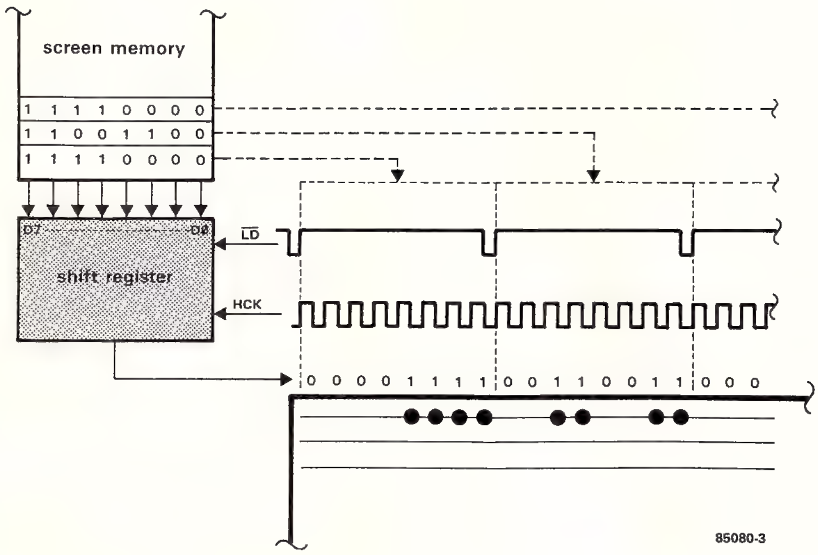


Figure 3. Production of a single-colour signal; three registers as shown are needed for a colour graphics card.

colours red, R, green, G, and blue, B. Any three primary colours can be mixed, in suitable proportions, to produce any other colour, except black. In other words, the colour is determined by the binary word formed by a combination of the three binary colour signals; this combination is also known as pel or pixel, both short forms of picture element.

The three colour signals are usually applied to the RGB inputs of the monitor. When the R input is high, and the other two low, the pixel will show up red; similarly, a high blue input and low R and G inputs will result in a blue pixel. Further primary colours are produced under the following conditions.

R (high) + G (high) + B (low) = yellow
R (low) + G (high) + B (high) = cyan (greenish blue)
R (high) + G (low) + B (high) = magenta (reddish blue)
R (high) + G (high) + B (high) = white
R (low) + G (low) + B (low) = black

The colour signals are output by three separate shift registers; this situation is shown for black and white or one colour in Figure 3. The registers are fed by three parallel banks of memories: each channel carries a signal as shown in Figure 2b. The line and field sync signals, the dot clock, and the load shift register are, of course, common to the three channels. Reiterating, there are thus **three bits with the same address** (but each in a distinct memory bank) for each pixel on the screen.

If the screen is black and its colour is required to be changed to, say, red, the R memory must be written to; if a yellow screen is required, the red and green memories should be accessed. This is, of course, true of not only the entire screen, but also of each individual pixel.

The graphics card must, therefore, have a dataline and a write select line common to the three memory banks, and also an individual select line. In practice, this requires two signals: one to indicate whether a bank is accessed or not; and the other to specify what is being done there. When the writing is green on a red background, for example, the pixels that are written must be accessed in both the green and the red memory. However, when the bit in the G memory is actuated, the same address in the red memory must be disabled. If this were not done, the pixel in the example just described would be green + red = yellow on a red background.

Note that a pixel being lit on the screen has a logic low level on the graphics card, and a high level when it is dark.

Part 2 will appear in our October 1985 issue.

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design ideas

voice recognition & speech processing

The subject of "speech and computers" has been discussed in these pages on several occasions, the last one being in the March 1985 issue.

The accent then was mainly on the speech processing aspect, which is technically easier than voice recognition. It is, therefore, fascinating for all those interested in this subject that General Instrument now have available two chips — the SP1000 and the VSR1000 — that, in combination, tackle the problems of both speech processing and voice recognition. The SP1000 is a voice recognition and synthesis IC, and the VRS1000 is an 8-bit microcomputer to control the SP1000.

The combination of the two chips provides the designer with complex, ready-to-use recognition and synthesis algorithms. Typical applications include robotics, aids for the handicapped, security devices, and voice-dial telephones.

The nucleus of the SP1000 is a lattice filter that can be programmed for synthesis and recognition modes. In the synthesis mode, the VRS1000 feeds the filter speech data it has computed: these data control the filter characteristics. In the recognition mode, the filter extracts from an incoming audio signal the LPC (linear predictive coding) information required for the digital speech processing.

To this end, the audio signal is scanned every 160 μs by an 8-bit analogue-to-digital converter; the resulting eight bits are fed to the SP1000, as shown in Figure 1. The filter extracts eight significant audio coefficients as well as relevant information as to audio signal amplitude: all this information is then stored on board the SP1000 and sent to the microprocessor every 20 ms.

Each spoken word is divided by the SP1000 into twelve frames, for each of which a time-weighted average of the coefficient is calculated and stored. This means that for each word a storage requirement of 108 bytes is required.

A single word should last no more than 2 seconds, and the space between two words should be not less than 200 ms. In this context, it is important that the audio signal level is matched to the input of the analogue-to-digital converter, so that the latter works under optimum conditions. To this end, the SP1000 has three "gain" outputs, which are fed to an external analogue gain control.

The LPC coefficients calculated by the VRS1000 are converted by the filter in the SP1000 into a digitally speech-modulated signal. Only a low-pass filter and a power amplifier are then required at the output to complete the synthesis process.

The VRS1000 is functionally equivalent and pin-by-pin compatible with the General Instrument Type PIC7040, which is a licensed, second-source of the Texas Type TMS7040. These ICs are 8-bit microprocessors with internal 4 K ROM. This ROM contains the entire program for the control of the SP1000.

During speech processing, the VRS1000 deals with the computation of the LPC coefficients extracted from the text provided by the host computer; during voice recognition, it compares the LPC coefficients provided by the SP1000 with the stored vocabulary. The VRS1000 can recognize twenty words simultaneously.

Other functions of the VRS1000 are: retraining of the vocabulary; creating vocabulary subsets; storing templates on disc; and rejecting a word that is found not to be a member of the recognition vocabulary.

Accuracy of voice recognition is claimed to be better than ninety-eight per cent according to the Doddington-Schalk standard test.

The search time, i.e., the time required to recognize or reject a word, depends on the size of the vocabulary: as a guide, 45 ms per word. It seems, therefore, sensible to sub-divide a vocabulary of, say, 100 words into five subsets of 20 words each; the search time will then always be less than 1 second.

It should be borne in mind that the recognition accuracy is bound to suffer with large vocabularies, since the likelihood of similar sounding words is then greater.

An advantage of the system is that a vocabulary has to be learnt: it is specific to a speaker, but can, none the less, be modified at any time. Furthermore, a number of speakers may enter their own specific vocabulary.

Since articulation, depth of voice, and speed of speech even in the same word spoken by the same speaker vary from time to time, it is possible to enter a word up to 255 times, and store the average. This, of course, results in very high recognition accuracy.

Characteristics — recognition mode	**Characteristics — processing mode**
• direct access to a 20-word vocabulary • 6.25 kHz sampling; 8 bits per sample • extraction of 8 LPC and 1 amplitude coefficient • maximum word duration 2 seconds • minimum pause between words of 200 ms • correction of temporary deviations in each of the twelve frames of a word • storage of 108 bytes per word • search time 45 ms per word • recognition accuracy 98 per cent • programmable rejection threshold • selectable number of training passes during the loading of the vocabulary	• 10 kHz sampling rate • variable frame rate • synthesis of 10 LPC coefficients • synthesis of sound effects and music • real-time interpolation of energy, pitch, and filter coefficients

Communication with the host computer is kept simple by the use of the ASCII code, so that it will normally not be a problem for individual control programs to be used.

Literature:
SP1000: preliminary information
Application note AN-0504
General Instrument
Times House
Ruislip HA4 8LE
Telephone: (089 56) 33355

General Instrument Corporation
International:
600 West John Street
Hicksville
New York 11802
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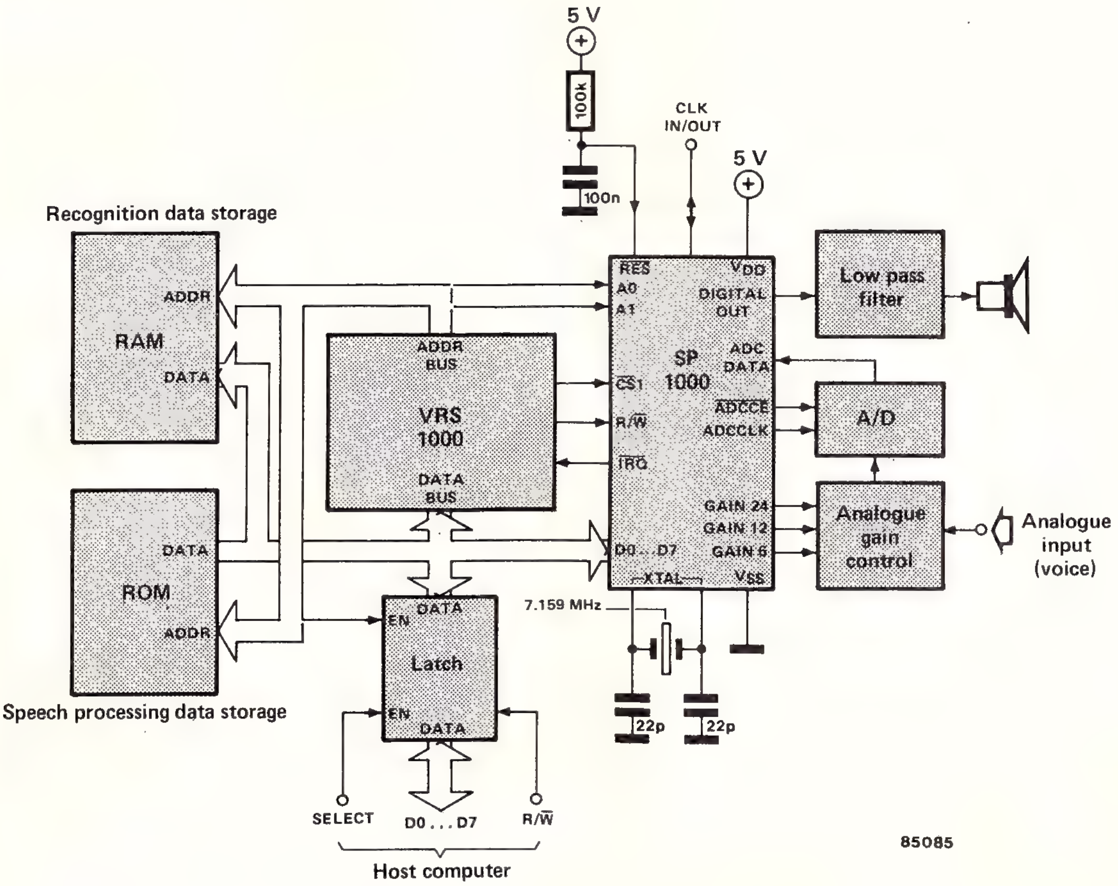
design ideas

Figure 1. The functional diagram of the SP1000/VRS1000 combination shows that only a few peripheral devices are required to design a complete voice recognition & speech processing unit for use with a microcomputer.

1



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B T App Secondary Socket	£1.95
4 way plug each **58p** 10	£5.50
B.T 4-core cable, per metre	15p
100 metres	£12
Cable clips for above 100	**75p**

CHART RECORDER SPECIAL

Brand new 3 channel pen recorders complete with charts Full spec upon request once only price **£40 + £10 p&p + VAT**

WALKMAN TYPE SPEAKERS

Powered Stereo Speakers complete with carrying strap. Built-in Pre-amp Needs to be heard to be believed Uses 2 × D size batteries — not supplied **£8.50** each (plus addtl. postage **£1**. set.)

ZENER DIODES

400mW Plastic 3V 75V	each **8p**	10/**75p**
1.3W Plastic 3V-200V	each **15p**	10/**£1.40**
1.5W Flange 4.7V 47V	each **£1.26**	
2 5W Plastic 7.5V 75V	each **64p**	
20W Stud 7 5V-75V	each **£1.35**	

NI-CAD

Universal Ni-Cad Charger charges PP3,AA,C,D
Price **£6.00**

RECHARGEABLE BATTERIES

AA (HP7)	**.85 ea.**	**10/75p ea.**
C (HP11)	**1.75 ea.**	**10/1.65 ea.**
D (HP2)	**2.05 ea.**	**10/1.95 ea.**
PP3	**3.80 ea.**	**10/3.70 ea.**

SPEAKERS

4" Round 1 6W 4 ohm. **£1.50** pair.
4" Round 1 6W 4 ohm. Plus Mounting Bracket. **£1.00** each.
2¼" Round 0 4W 8 ohm. **£0.85** each.

Potentiometers

Carbon Track, Rotary 0.25 W Log & Lin values. All ¼" Spindle, 20 ml body dia, Shaft 2' long.

4K7 — 2M2 Single Gang Log	.32	10/**£3.00**
1K — 2M2 Single Gang Lin	.32	10/**£3.00**
5K — 2M2 Single Gang DP Switch Log	.75	10/**£7.00**
5K — 2M2 Double Gang Log & Lin	.86	10/**£8.25**

DE-LUXE EMERGENCY LITE

Operates from 12V DC, comes complete with 4 metres of cable & cigar lighter plug for easy operation. Magnet base & solid state controlled blinking switch are incorporated. **99p**

PERSONAL STEREO CASSETTE

Current stock incl. Omega & Murphy. Sorry — at this price we send what we have in stock at time. Complete with carrying strap & Headphones **£9.99** ea. (plus addtl postage **50p.**).

CERAMIC CAPACITOR PACK

50V. Ceramic Capacitors — 5 each value
25 values — each value individually marked and packed — 125 total. **£3 50** per pack

ZENER DIODE PACK

400mW — 5 each value — 11 values — individually marked and packed - 55 Zener Diodes. **£3.00** per pack.

RESISTORS – CARBON FILM 5%

¼W 1RO to 10M (E12 Range)	**2p each**	**15p/10**	**75p/100**
¼W 2R2 to 10M (E24 Range)	**2p each**	**15p/10**	**75p/100**
1W 10R to 2M2 (E12 Range)	**7p each.**	**65p/10.**	**6.00/100**
2W 10R to 2M2 (E6 Range)	**8p each**	**70p/10**	**6.00/100**

RESISTOR KITS – each value individually packed

¼W pack 10 each value E12 — 10R to 1M 610 pieces	**5.00**
¼W pack 5 each value E12 — 10R to 1M 305 pieces	**3.00**
½W pack 10 each value E12 — 2R2 to 2M2 730 pieces	**6.00**
½W pack 5 each value E12 — 2R2 to 2M2 365 pieces	**3.50**
1W pack 5 each value E12 — 2R2 to 1M 353 pieces	**15.00**
2W pack 5 each value E6 — 10R to 2M2 317 pieces	**18.00**

RESISTORS – WIREWOUND Generally 5%

2 5W — 0 22 to 270R — Available in preferred values	**0.20**
4W — 1R0 to 10K — Available in preferred values	**0.21**
7W — 0 47R to 22K — Available in preferred values	**0.25**
11W — 1R0 to 22K — Available in preferred values	**0.29**
17W —1R0 to 22K — Available in preferred values	**0.37**
Support Pillars for 4W/7W/11W/17W	£30p. 10
25W 0.47R to 470R	£1.48
50W 0.47R to 470R	£1.85

D.C. MOTORS (Min.)

6 – 12V. **75p.** **£3.00/5**

SCREENED CURLY LEADS

Black — 3-core (2 metres extended) **75p**. each **£6.00** 10

CAPACITORS

Mixed Dialectic.

.01mf	1000V	.40
022mf	1000V	.48
1mf	1000V	.52
47mf	1000V	£1.25

I C SOCKETS

Dil to Dil

8 pin	**0.08**	**0.70/10**
14 pin	**0.10**	**0.95/10**
16 pin	**0.11**	**1.00/10**
18 pin	**0.14**	**1.60/10**
22 pin	**0.21**	**1.95/10**
24 pin	**0.25**	**2.25/10**
28 pin	**0.30**	**2.75/10**
40 pin	**0.34**	**3.10/10**

MIN. "D" CONNECTORS

		9way	15way	25way	37way
PLUGS	Solder Lug	.52	.65	.88	1.45
	R. Angle	.89	1.34	1.98	3.48
SOCKETS	Solder Lug	.78	.98	1.33	2.48
	R. Angle	1.18	1.78	2.70	4.15
COVERS		.95	.95	.98	1.00

FUSES Prices per 10

1¼" Quick Blow 100, 150, 250mA **£1.30** 1, 1.25, 1 5, 2, 2.5, 3, 10, 15A **55p. 1¼" Time Delay** 100mA **£3.50** 150mA **£2.25** 250, 300, 500, 600, 750, 850mA **£1.84** 1, 1 25, 1 5, 1 6, 2A **£1.84** 2 5A, 3 15, 3, 5A **£2 82. 20mm Quick Blow.** 100, 125, 160, 200, 250, 315, 400, 500, 630, 800mA, 1, 1 25, 1 6, 2, 2.5, 3 15, 4, 5, 6.3A. **40p 20mm Time Delay** 100, 125, 160, 200mA **£1 80.** 250, 315, 400, 500, 630, 800mA. **£1.00.** 1, 1.25, 1 6, 2, 2 5, 3 15, 4, 5, 6.3A **85p 1" Mains.** 2, 3, 5, 7, 10, 13A **85p.**

TERMINAL BLOCKS

2 amp 12 way	**20**
5 amp 12 way	**24**
15 amp 12 way	**42**
32 amp 12 way	**88**

INTEGRATED CIRCUITS (£) EACH

CA3065	1.75
CA4102	3.30
CA4422	3.07
LC7120	5.33
LC7130	5.26
LC7137	5.16
LM380N	1.65
LM1303N	2.52
HA1151P	3.12
MC1307P	1.85
MC1310P	1.85
MC1312P	2.25
MC1327P	1.25
MC1330P	0.83
MC1349P	1.05
MC1350P	1.20
MC1351P	2.50
MC1352P	1.50
MC1357P	2.88
MC1496L	1.15
ML231B	2.10
ML232B	2.10
ML237B	2.30
NE555	0.35
C-mos 555	0.88
SAA1024	5.35
SAA1025	8.40
SAS560A	2.50
SAS560S	1.85
SAS570S	1.85
SAS580	2.85
SAS590	2.82
SC9503P	1.10
SL432A	4.00
SL901B	5.20
SL917B	6.25
SL1327Q	1.10
SN76003N	2.44
SN76013N	1.90
SN76023ND	2.90
SN76033N	2.45
SN76110N	1.12
SN76115N	2.00
SN76131N	1.65
SN76226DN	1.80
SN76227N	1.10
SN76530P	1.40
SN76533N	1.60
SN76650N	1.05
SN76660N	0.75
SN76666N	0.80
STK015	6.50
TA7108P	3.20
TA7120P	2.20
TA7129AP	3.65
TA7130P	1.65
TA7172	1.80
TA7193	5.50
TA7172P	1.80
TA7176	2.50
TA7202P	4.18
TA7204P	1.86
TA7205AP	1.50
TA7208P	3.27
TAA550	3.50
TAA700	2.80
TAA840	3.38
TAD100	2.80
FM FILTER	1.20
TBA120 AS.	
S,SA,SB	1.30
Q,T,U,UQ	1.32
TBA120B	1.30
TBA231	1.45
TBA281	2.65
TBA395	1.20
TBA480Q	1.50
TBA400	2.30
TBA510	2.60
TBA510Q	2.60
TBA520/Q	1.60
TBA530/Q	1.30
TBA540/Q	1.40
TBA550/Q	1.52
TBA560C	1.70
TBA560CQ	1.60
TBA570	1.50
TBA673	2.40
TBA700	2.85
TBA750	2.80
TBA800	1.60
TBA810P	1.10
TBA810S	1.20
TBA820	1.60
TBA890	3.88
TBA920/Q	3.00
TBA950/2A	3.05
TBA970	4.05
TBA990	1.88
TCA160C	3.90
TCA270S	4.00
TCA270SA	4.02
TCA800	7.50
TCA940	1.90
TDA440	3.80
TDA1002	1.90
TDA1003A	5.50
TDA1004A	3.75
TDA1006A	2.40
TDA1035S	4.50
TDA1044	4.30
TDA1170S	3.00
TDA1190	3.50
TDA1200	2.98
TDA1270Q	3.70
TDA1327A	1.66
TDA1352A/B	1.56
TDA1412	1.20
TDA2002	2.80
TDA2020	4.60
TDA2030	2.78
TDA2140	5.90
TDA2521	4.10
TDA2523	3.50
TDA2530	2.70
TDA2540	3.80
TDA2541	3.80
TDA2560	3.50
TDA2571A	2.50
TDA2581	3.20
TDA2590	3.20
TDA2591	2.98
TDA2593	2.98
TDA2610	3.20
TDA2611A	1.94
TDA2640	2.90
TDA2680	3.40
TDA2690	3.50
UPC554C	1.32
UPC557H	0.90
UPC566H	2.95
UPC575C2	3.20
UPC1018C	1.10
UPC1025H	2.90
UPC1032H	0.90
UPC1156H	4.20
UPC1158H	0.76
UPC1163H	0.98
UPC1181H	1.60
UPC1185H2	3.75
UPC1212C	1.30
UPC1230H	3.90
UPC1350C	4.25
UPC1367C	3.40
UPC1378H	4.40
UPC2002H	2.80

VALVES

Type	Price (£)
DY802	0.88
DY86 87	0.75
ECC81	1.27
ECC82	0.98
ECC83	0.75
ECC84	0.90
ECC85	0.90
ECC88	0.95
ECF80	0.95
ECH81	0.75
ECH84	0.75
ECL82	0.75
ECL86	0.98
EF80	0.65
EF86	1.60
EF183	0.75
EF184	0.75
EH90	0.94
EL34	3.25
EL84	0.69
EL509	5.50
EM87	2.55
EY86 87	0.67
EY500A	1.65
PCC84	0.50
PCC85	0.65
PCC89	0.74
PCC189	0.85
PCF80	0.75
PCF86	1.25
PCF200	1.95
PCF801	1.45
PCF802	1.00
PCF806	1.20
PCL82	0.90
PCL83	2.50
PCL84	0.90
PCL86	1.15
PCL805 85	1.35
PD500	3.75
PFL200	1.35
PL33	1.50
PL36	1.45
PL81	0.85
PL82	0.75
PL83	0.65
PL84	0.75
PL95	2.00
PL504	1.20
PL508	2.40
PL509 519	5.95
PY88	1.80
PY500A	2.40
U26	1.90
UCH81	0.90
UCL82	1.70
6J5GT	1.75
6SJ7	2.20
30EL12	1.60

TRANSISTORS + DIODES

Type	Price (£)
AC127	0.30
AC128	0.30
AC128K	0.34
AC132	0.55
AC141	0.26
AC141K	0.40
AC142	0.26
AC142K	0.48
AC151	0.45
AC152	0.45
AC176	0.28
AC176K	0.46
AC187	0.42
AC187K	0.48
AC188	0.44
AC188K	0.50
ACY40	0.88
AD142	1.10
AD143	1.10
AD149	0.96
AD161	0.42
AD162	0.42
AD161	
AD162	0.98
AF106	0.48
AF114	2.10
AF115	2.10
AF116	2.10
AF117	2.10
AF118	0.85
AF121	0.62
AF124	0.48
AF125	0.48
AF126	0.48
AF127	0.48
AF139	0.68
AF178	0.68
AF239	0.68
AF279S	0.75
AL100	2.50
AL102	5.90
AL113	2.20
ASY80	1.75
AU110	1.40
AY102	4.32
BA102	0.34
BA110	0.67
BA121	0.40
BA129	0.38
BA148	0.16
BA154	0.08
BA155	0.10
BA156	0.08
BA157	0.28
BA164	0.14
BB104B	0.52
BB105B	0.30
BB105G	0.48
BB110B	0.42
BC107	0.10
A or B	0.12
BC108	0.10
A, B or C	0.12
BC113	0.14
BC114	0.12
BC115	0.12
BC116	0.15
BC117	0.22
BC118	0.17
BC119	0.30
BC125	0.12
BC140	0.28
BC141	0.42
BC142	0.30
BC143	0.30
BC147	0.08
A or B	0.10
BC148	0.08
A or B	0.10
BC149	0.09
BC157	0.10
BC158	0.10
BC159	0.10
BC160	0.30
BC161	0.30
BC168B	0.12
BC169C	0.10
BC170	0.14
BC170B	0.12
BC171	0.10
A or B	0.08
BC172	0.08
A or B	0.12
BC177	0.20
BC178A	0.22
BC182	0.09
A, B or C	0.09
BC182L	0.09
A, B or C	0.09
BC183	0.09
A, B or C	0.10
BC183L	0.08
A, B or C	0.12
BC184L	0.10
A, B or C	0.10
BC207	0.15
BC208	0.16
BC212	0.09
A, B or C	0.10
BC212L	0.08
A, B or C	0.10
BC213	0.09
A or B	0.10
BC213L	0.10
A or B	0.10
BC237	0.11
BC238	0.12
BC239C	0.14
BC251	0.12
A, B or C	0.14
BC301	0.30
BC302	0.32
BC303	0.32
BC307	0.10
BC308A	0.10
BC323	0.99
BC327	0.14
BC328	0.14
BC337	0.12
BC338	0.12
BC350	0.14
BC440	0.30
BC441	0.32
BC461	0.32
BC547	0.12
BC548	0.12
BC549	0.12
BC550	0.18
BC550C	0.18
BC557	0.12
BC558	0.12
BCX34	0.27
BCY70	0.15
BCY71	0.17
BCY72	0.18
BCZ10	1.68
BCZ11	1.45
BD124P	0.80
BD130Y	0.68
BD131	0.34
BD132	0.34
BD131 132	0.95
BD135	0.32
BD136	0.36
BD137	0.36
BD138	0.38
BD139	0.38
BD140	0.38
BD144	1.60
BD145	1.82
BD150A	0.51
BD159	0.65
BD160	1.65
BD165	0.45
BD175	0.60
BD182	1.00
BD183	1.10
BD184	1.20
BD201	0.72
BD202	0.87
BD204	0.80
BD222	0.80
BD225	0.86
BD232	0.45
BD233	0.60
BD234	0.62
BD235	0.63
BD236	0.63
BD237	0.65
BD238	0.56
BD241	0.60
BD243A	0.80
BD244A	0.55
BD375	0.32
BD410	0.76
BD434	0.68
BD436	0.68
BD437	0.76
BD438	0.75
BD439	0.68
BD507	0.48
BD508	0.53
BD509	0.54
BD510	0.48
BD517	0.56
BD520	0.66
BD699	1.25
BD707	0.88
BDX18	2.35
BDX32	2.10
BF115	0.32
BF117	0.54
BF119	0.82
BF120	0.38
BF123	0.40
BF125	0.42
BF127	0.38
BF152	0.16
BF154	0.23
BF157	0.40
BF158	0.22
BF159	0.24
BF160	0.23
BF167	0.30
BF173	0.25
BF177	0.42
BF178	0.30
BF179	0.32
BF180	0.35
BF181	0.35
BF182	0.32
BF183	0.32
BF184	0.32
BF185	0.32
BF194	0.08
BF195	0.10
BF196	0.10
BF197	0.10
BF198	0.14
BF199	0.16
BF200	0.26
BF222	0.48
BF224	0.20
BF224J	0.16
BF240	0.20
BF241	0.20
BF244	0.26
BF244A	0.28
BF244C	0.24
BF245A	0.28
BF254	0.15
BF256	0.40
BF257	0.32
BF258	0.30
BF259	0.32
BF262	0.30
BF263	0.30
BF270	0.30
BF271	0.26
BF273	0.18
BF274	0.32
BF323	0.92
BF336	0.26
BF337	0.38
BF338	0.38
BF355	0.42
BF363	0.82
BF367	0.24
BF371	0.27
BF422	0.38
BF450	0.38
BF457	0.33
BF458	0.36
BF459	0.44
BFR39	0.22
BFR40	0.22
BFR41	0.22
BFR51	0.30
BFR61	0.32
BFR62	0.28
BFR88	0.34
BFR90	1.72
BFT41	0.38
BFT43	0.38
BFW10	0.79
BFW44	0.75
BFX29	0.28
BFX30	0.30
BFX80	3.56
BFX84	0.24
BFX85	0.26
BFX86	0.26
BFX87	0.26
BFX89	0.65
BFY50	0.21
BFY51	0.21
BFY52	0.21
BFY57	0.40
BFY90	0.90
BFY90S	1.34
BR100	0.20
BR101	0.44
BR103	0.58
BRC4443	1.76
BRY39	0.38
BRY56	0.42
BRY61	0.86
BSS17	0.56
BSS27	0.92
BSX19	0.34
BSX20	0.34
BSX59	0.62
BSX76	0.29
BT100A 02	0.94
BT101/300	1.15
BT101/500	1.25
BT102/300	1.35
BT102/500	1.65
BT106	1.50
BT108	1.30
BT109	1.18
BT116	1.25
BT119	3.62
BT120	3.60
BT121	3.02
BT138 600	1.30
BT151 560R	0.90
BT151 300R	1.15
BTY79 400R	2.80
BU100A	2.30
BU104	2.00
BU105	1.20
BU105 02	1.56
BU108	1.80
BU124	1.75
BU126	1.25
BU133	1.80
BU204	1.35
BU205	1.30
BU206	1.70
BU208	1.55
BU208A	1.63
BU208 02	2.05
BU326S	1.75
BU407	1.65
BU407D	1.80
BUX80	3.70
BUY20	1.75
BUY69A	2.60
BUY69B	1.98
BY101	0.48
BY118	1.10
BY122	0.68
BY126	0.12
BY127	0.10
BY133	0.16
BY135	0.25
BY164	0.44
BY179	0.66
BY182	0.87
BY184	0.40
BY187	0.72
BY189	4.75
BY198	0.44
BY199	0.47
BY206	0.24
BY207	0.24
BY210 400	0.25
BY210 600	0.26
BY210 800	0.30
BY223	1.20
BY227	0.26
BY229	0.30
BY238	0.68
BYX10	0.24
BYX36 150	0.22
BYX36/600	0.28
BYX48/300	0.72
BYX49 300	0.47
BYX55 350	0.29
BYX55/600	0.33
BYX71 600	1.18
BYZ12	0.42
C106D	0.80
E1222	0.40
E5024	0.30
GET872	0.48
ITT44	0.04
ITT2002	0.11
ME0402	0.20
ME0404 2	0.24
MEU21	0.60
MJ400	1.25
MJ2955	0.90
MJ3000	1.98
MJE240	0.60
MJE340	0.54
MJE370	0.88
MJE520	0.48
MJE2955	0.99
MJE3055	0.70
MPSL01	0.28
OA47	0.10
OA90	0.08
OA91	0.09
OA95	0.18
OA200	0.06
OA202	0.15
OC25	2.10
OC26	1.70
OC28	1.50
OC29	2.47
OC35	1.75
OC36	1.75
OC42	0.72
OC42K	1.40
OC44	0.72
OC45	0.58
OC71	0.50
OC72	0.52
OC81	0.68
OC200	2.46
OC202	2.20
ORP12	0.85
R2008B	1.50
R2010B	1.52
SHG1 5	0.40
TAG1 100	1.40
TAG3 400	1.78
TIC44	0.40
TIC45	0.45
TIC46	0.48
TIC47	0.70
TIC106A	0.70
TIP30A	0.46
TIP31C	0.54
TIP32	0.40
TP32C	0.60
TIP33A	0.63
TIP34A	0.72
TIP41C	0.46
TIP42A	0.52
TIP47	0.60
TIP110	0.88
TIP2955	0.60
TIP3055	0.60
TIS43	0.88
TIS88	0.40
TIS90	0.25
TIS91	0.28
ZTX108	0.12
ZTX109	0.12
ZTX212	0.28
1N4001	0.05
1N4003	0.05
1N4004	0.06
1N4006	0.07
1N4007	0.07
1N4148	0.05
1N5400	0.12
1N5402	0.15
1N5405	0.16
1N5406	0.18
1N5408	0.20
1S920	0.08
2N697	0.55
2N706A	0.33
2N2904	0.28
2N2906	0.24
2N2926G	0.10
2N3053	0.40
2N3054	0.56
2N3055	0.45
2N3702	0.10
2N3704	0.10
2N3708	0.10
2N3772	1.90
2N3773	2.70
2N3904	0.16
2N3906	0.16
2N5294	0.48
2N6107	0.71
2N6126	0.68
2SB337	1.60
2SC1172Y	2.90
2SC1173Y	0.82
2SC1302	1.40
2SC1226	0.87
2SC1279	0.50
2SC1306	0.92
2SC1307	1.40
2SC1413A	2.70
2SC1444	1.45
2SC1507	0.63
2SC1678	1.06
2SC1758	0.68
2SC1909	1.20
2SC1923	0.30
2SC1945	2.88
2SC1953	0.74
2SC1957	0.76
2SC1969	2.88
2SC2028	0.73
2SC2029	2.10
2SC2078	1.05
2SC2091	0.73
2SC2098	2.90
2SC2122A	3.20
2SC2166	1.20
2SC2314	0.80
2SC2335	1.50
2SC2749	2.70
2SC2752	0.60
2SD234	0.64
2SD348	3.30
2SD986	0.62
2SK134	3.80
2SK135	4.60
3N126	1.90
3N211	2.52
3SK45	0.76

CMOS

4000	24p
4001	24p
4002	25p
4007	25p
4011	24p
4012	24p
4013	56p
4014	60p
4015	60p
4016	40p
4017	60p
4018	60p
4020	85p
4021	58p
4022	96p
4023	35p
4024	50p
4025	24p
4027	45p
4028	45p
4029	75p
4030	35p
4031	1.30p
4033	1.25p
4034	1.46p
4035	70p
4036A	2.75p
4038	75p
4039A	2.80P
4040	60p
4042	50p
4043	42p
4044	50p
4046	60p
4049	38p
4050	36p
4051	70p
4052	60p
4053	60p
4066	45p
4067	2.45p
4068	24p
4069	24p
4070	25p
4071	24p
4072	25p
4073	25p
4075	25p
4076	68p
4077	25p
4078	25p
4081	25p
4082	25p
4085	58p
4086	58p
4089	1.25p
4093	37p
4094	95p
4095	95p
4096	99p
4097	2.65p
4098	80p
4099	1.05p
4161	96p
4162	96p
4163	96p
4174	96p
4175	1.00p
4194	99p
4501	38p
4502	38p
4503	40p
4507	48p
4508	1.30p
4510	55p
4511	55p
4512	55p
4513	55p
4514	1.15p
4515	1.15p
4516	55p
4517	2.70p
4518	48p
4520	53p
4521	1.15p
4522	1.25p
4526	60p
4528	68p
4531	1.30p
4532	65p
4536	2.65p
4538	80p
4539	90p
4541	90p
4543	1.25p
4549	4.00p
4553	2.45p
4554	1.92p
4555	35p
4556	55p
4557	2.50p
4558	1.20p
4559	3.25p
4560	1.80p
4562	3.50p
4566	1.75p
4569	1.95p
4583	1.05p
4584	55p
4585	70p
4724	1.10p

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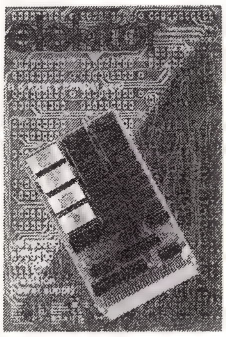
E34, February 1978
Infra-red Light Gate/Throwing Some Light on LEDs/Format – the Elektor Music Synthesiser (ç)/Slow on/off/CMOS Function Generator/Zener/Tester/Development timer/Experimenting with the SC/MP (4).

E38, June 1978
¼ GHz Counter/Constant Amplitude Squarewave to Sawtooth Converter / Servo Polarity changer / Monopoly Dice / Mini Counter / Digital clock Using the SC/MP/Programmable Call Generator / TV Sound Modulator/ Automatic Stereo Switch/Trafic Light controller.Easy Music.

E54, October 1979
Touch Tuning/Battery Saver/Impedance Bridge/New Programs for the SC/MP/Digital Rev Counter/Digifarad/Short-interval Light Switch/PCB for Variable Fuzz Box/Gate-dipper/Strain Gauge/I Played TV Games/Programmable Sequencer.

E55, November 1979
Topamps/Flash Sequencer/Electronnics the Easiest Way/Remote control Motor Switch/Home Trainer/fuel Economiser/I Played TV Games (2)/Shortwave converter/Ionosphere/Low Voltage Dimmer/I See your Point/Servo controlled Motor.

E58, February 1980
Aerial Booster/Fet Opamps in the Formant / TV Interference Suppression / Elektor Vocoder (2)/ Aerial Amplifiers / Digisplay/ Analogue Delay Technology / Extending the ¼ GHz Counter/ Digital Thermometer.



E65, September 1980
8K RAM + 4.8 or 16K EPROM on a Single Card/Precision Power Unit/Electronic Linear Thermometer/The Josephson Computer/VOX Printed Circuit Board/ Ejektor: Measuring Multipath/ High Speed Readout for Elekterminal/Musical Box/Electrolytology/Curve Tracer/Using the Vocoder.

E66, October 1980
Programmable Slide Fader/Touch Doorbell/Switched Capacitors/ More TV Games/The Junior Computer Memory Card/Remote Control Slide Projector/Video Pattern Generator/LCD Tuning Scale/ Dual Slide Faders.

E67, November 1980
An r.p.m. Indicator as an Economy Guide/Draught Detectir/How to Recycle Dry Cell Batteries/ Energy Saving Know-how/Simple fuel Economy Meter/Automatic Pump Control/Long Life Technique in Light Bulbs/Automatic Curtain Control/Fridge Alarm/ Know the ins and outs of your Central Heating system/Energy/ Energy Saving Motor Control/Coffee Machine Switch/Operational Hours Counter.

E68, December 1980
Canned Circuits: 23 of the best entries which include Midnight Raid Detector/A 'Flash in the Can'/ Canometer/Canine Defence.

E70, February 1981
Audio Power Meter/Noise Reduction/Process Timer/High voltage from 723/Juniors Growing Up/ The Voiced/Unvoiced Detector/Emergency Brake for the Power Supply/150 W DC to DC Converter for the Car/Low Noise 2 Metre Pre-Amp/2½ Digit DVM/ Wagnephon.

E72, April 1981
Transistor Match-maker/Universal Power Supply/Intelekt/Humidity Sensor/Logic Analyser II/Crystal-controlled Stroboscope/Junior Cookbook.

E73, May 1981
Camping Clock/Frequency Double/The Fully Fledged Junior Computer/Talk to Computers/ Choke Alarm/Bar Codes/Logic Analyser/Waveform Generator/ Sophisticated software for the Junior Computer/Reading Bar Codes.

E77, September 1981
DFM + DVM/Revolution Counter/Digital Barometer/dB Converter/TV Games Extended/Disco Lights Controller/QUAD ESL 63/ Analogue LED Display/Volt/Ammeter for Power Supplies/Chattering Chips/Transistor Ignition Update/Soldering Aluminium.

E89, September 1982
Gas Detector/Rapid Loading Games/The Elektor Connection/ Inductive Sensor/Darkroom Computer Part 1/Applikator/Home Telephone System/Synthesised Sound Animation/Time Receiver for the Rugby MSF/Three Phase Tester.

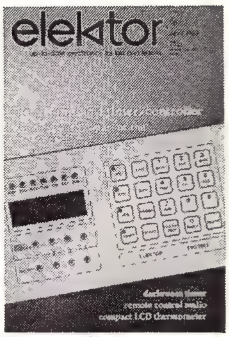
E90, October 1982
DSB Demodulator/L.C.D. Thermometer/Ultra Sonic Distance Measurement/Electrolytics Run Dry/Darkroom Computer Part 2/Short Wave Band Shifting for SSB Receiver/16 Channels with only Five ICs/Pre-amp for the SSB Receiver/Active Aerial/Transistor and IC Data.

E91, November 1982
Drum Interface/Talking Dice/ Model Train Lighting/Guitar Tuner/Cerberus/Floppy Disc Interface for the Junior/Cubular Bell/Mini-Organ Extension/Kitchen Timer.

E93, January 1983
Milliohmmeter/accessories for the Crescendo power amplifier/Darkroom computer tips/Chips for digital audio / 3 A computer supply/Traffic-light control system / Tomorrow's music / Upper and lower case on the Elekterminal.

E94, February 1983
Prelude part 1/VAM – video/ audio modulator/Main beam dimmer/Prelude class A headphone amplifier/Fuse protector/Acoustic telephone modem/Double dice/ Chips for digital audio part 2.

E96, April 1983
Low power digital thermometer/ MC/MM phono preamp/Membrane switches/Interlude/RC equalizer / 7-day timer / controller/Junior program tester/ Prelude (part 3)/Programmable darkroom timer/Talking clock extension.



E97, May 1983
Wattmeter/ASCII keyboard/Prelude p.s./Multitester/Maestro (part 1)/What is power?/Parallel-serial keyboard converter/Morse converter/78L voltage regulators ...and 79L/Morse decoding with the Z80A.

E99/100, July/August 1983
Summer Circuits Double Issue containing over 100 projects.

E101, September 1983
Video Graphics/Autotest/64k on the 16k Dynamic RAM Card/high-speed CMOS/VDU Card/Personal FM/Precision Voltage Divider/ alarm Extension/Junior Synthesizer/Simple MOSFET Test.

E102, October 1983
Basicode-2 / Music Quantisizer/ Solid-state Darkroom Lighting/ High-voltage Regulator / Anemometer / Programmable Power Supply/Basicode-2 Interface for the Junior Computer/Electronic Voltage Regulator / Battery Eliminator/Transistor Selector/FSKleaner/EPROMmer using the Junior Computer.

E103, November 1983
Doorbell – or telephone – operated flashlight/Power Controller for Model Railways/ Decoupling in Digital Circuits/CPU Card/Decimal to Binary Converter/Movement Detector/Electronic two-tone Metronome/ Pseudo Stereo/Universal Terminal/Ultrasonic/Infrared Barrier/Trick battery/Crescendo revisited.

E104, December 1983
64-way 2-dimensional Bus Board/MF/HF USB Marine Receiver/LED Ornaments/Symmetrical Power Supply/Video Amplifier/Locomotive Headlamp Reverser/Frost Warning Device/ Disco Phaser/Banking Program/ NOV-RAM: Data Storage without Batteries/Bus Extension/ + Cumulative index 1983.

105, January 1984
Gyrophone/How accurate is your watch?/Digital Cassette Recorder/Audio Signal Embellisher/ Universal Active Filter/from Thermometer to Thermostat/Audio Sleuth at work/Wind Direction Indicator/Z80 EPROM programmer/ Home-made low-cost Wiring Probe/Address deding.

E106, February 1984
6502 Tracer/Diesel Tachometer/ Programmable Disco Display Lights/Video Combiner/Digitester with a difference/Reversing Buzzer/Memory timing/Mating Logic Families/Capacitance Meter/Basicode 2 for Junior plus VDU Card/Constant Voltage Source/CS Chip Selekt/Video Sync Box.

E107, March 1984
Petrol Saver/Triac Control Board/ UHF Video and Audio Modulator/ GET & GO/Elabyrinth/Varistor Protection Circuits / Real-Time analyser (part 1)/Applicator/Tape Timer.

E108, April 1984
Optical Memories/Controlling the Floppy-disk Drive Motor/Pulse Generator/Using the Pulse Generator/Intelligent EPROM Eraser/ Z80 simulator/Metronome Extension/Real-time analyser, part 2/ Variable A.C. Power supply/Idlist/ Chip Selekt/Tape Contents Detector.

E109, May 1984
Noise Squelch/Short-wave Pocket Radio/Floppy Tester/ Switching Power Supply/Analytical Video Display/Aviary Illumination/How many Watts?/Mini Crescendo/a look at EXOR and EXNOR Gates/EPROM Copier/ Digital Cassette Recorder revisited/Real-time Analyser, part 3/RS423 Interface.

E110, June 1984
Portable Distress Signal/ZX Extensions/Disco Drum/Daisywheel Typewriter Printer Interface/Maximum and Minimum Memory/ Lead-acid Battery Charger/Wireless Microphone/Merging BASIC Programs/Echo Sounder/Versatile Audio Peak Meter.

E111/E112, July/August 1984
Summer Circuits Double Issue containing over 100 projects.

E113, September 1984
Data Communication by Telephone/Active cross-over Filter/ Digital Cassette Recorder with the ZX81/Flash Meter/Digital Tachometer/DIRPUT/SCART Adapter/ Anodizing Aluminium / Lamp Saver/Double-sided Printed Circuit Boards

E114, October 1984
The Sinclair QL – first impresions/Basicode-2/Tuning Fork/Balancing Transformers Video colour Inverter/Programming the 6845/ZX81 Cassette Pulse Cleaner/Direct-coupled Modem/ Battery Tester/RS232 centronics Converter/Dynamic Pre-amplifier.

E115, November 1984
The Story of Valves/Autodim/ Mini Printer/Burglar Deterrent/ How to make your own PCBs/ RS232/V24: the Signals/Use your TV Receiver as a Monitor/Telephase/Valve Amplifier/Electronic Gas Meter.

E116, December 1984
Electronic Candle/The XR2206 in the function Generator/Shorthand BASIC/Function Generator/Time Switch/Cumulative Index 1984/ Musical Greeting Cards/Give your Soldering Tip a longer Life/ Computer-controlled Slide Fader/Slot-car Controller/Microprocessor-controlled Frequency Meter (part 0).

E117, January 1985
Commodore Cassette Interface/VHF/UHF Modulator/Portable Guitar Amplifier/30 watt a.f. Output Stage/JSR swap/Rumble Detector/μP-controlled Frequency Meter/Switching Radio Control Channels.

E118, February 1985
Gyroflash/1.2 GHz Input Stage/ Microphone Preamplifier/Remote Model Control by Microcomputer/ DIY Connector/Programmable Rhythm Box/EPROM Selector/Receiver Power from Engine Battery/RLC Meter/Programmable Keyboard Encoder.

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new literature

Micro products handbook

This handbook provides a comprehensive body of information on the technology, features, and benefits of Emulex Corporation's line of micro products, and includes a detailed description of the versatile new Small Computer Systems Interface (SCSI).

The text and specifications of the handbook are organized to present an overview of each major product line. This includes background on the operational environment of the products, as well as characteristics of the peripheral devices supported.

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Integrated Computer Systems announces two new courses in their comprehensive video training series on microprocessor troubleshooting, and a comprehensive video course on microprocessor technology and applications. These courses are on videotape.

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A practical introduction to the new logic symbols

by Ian Kampel
ISBN 0 408 01461 X
Price £11.50

This interesting book was unfortunately received too late for a full preview in this issue, and is therefore held over until next month.

Butterworths
Borough Green
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Interfacing the BBC Microcomputer

by B Bannister and M Whitehead
ISBN 0 333 37157 7
Price £7.50

In yet another in the excellent series of books about the BBC micro, all possible aspects of interfacing this popular computer are discussed. In choosing the BBC micro, many people will have been persuaded by the great number of interface possibilities. After all, the B model not only has an RS423, a Centronics, a video, and an RGB output, but also a number of special ports: the user port, the 1 MHz bus, the analogue port, and the TUBE. These are powerful facilities, but what exactly are they and how are they to be used? It is to these questions that this book gives the answers.

The book is divided into two parts, with the second containing some fifty pages copy datasheets, which, in our opinion, is rather too much. The first part, however, deals in a clear and detailed manner with each of the special ports. It also explains Acorn's intentions with the various memory ranges and which of these may be used at will. This information is priceless for the serieus BBC user. The use of machine language is also described clearly. The book contains a couple of small circuits, which enable some experimenting with the user port.

The description of the analogue port is probably one of the most valuable parts of the book, because it is in this that the BBC micro stands out from other home computers. This section is an extensive and thorough addition to the User Guide and the Advanced User Guide.

The TUBE, which makes the possibilities of the BBC almost limitless, is described in a manner which leaves the reader in no doubt as to how the memory range of the BBC micro may be extended. This is, however, not a port that is suitable for home experiments, because it needs to be used with a ULA (uncommitted logic array).

This book offers the BBC user a wealth of information on his computer and this makes the book more than worth the cover price.

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The Microcomputer Users' Year Book

The increasing importance of distributed data processing within larger organizations and the acceptance of micros as an essential business tool in smaller organizations has emphasized the need for a hardware and services directory which goes beyond the simple buyers guides available until now. The new year book, which fills this gap, is packed with information, but design makes it easy to use. It has major sections on products, services, suppliers, and contains background articles at the start of each subsection. Published by Computing Publications, Evelyn House, 62 Oxford Street, London, W1A 2HG, the book is available at £35 plus £2 UK postage from

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Optical sensors directory

ERA Technology is currently compiling a directory of all the essential components required in the design and development of optical sensors based on optical and opto-electronic techniques. The directory will contain comprehensive company and product details and a major feature will be product tables giving the key technical parameters for both components and materials.

ERA expects the directory to become a prime data source for all those involved in the design and development of optical sensors. The first edition, which will be published during summer 1985, will cover products available for users in the UK. Later editions will be extended to include Europe, the USA, and Japan.

ERA Technology Limited
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Telephone: (0372) 374151 Ext. 461

Texas Instruments has published a new linear and interface circuits catalogue and a new edition of its line circuits brochure.

Linear & Interface Products details the complete TI spectrum of analogue and interface circuits.

In addition to an alphanumeric listing of device types and functions, there are sections giving parametric data for each device, new product highlights, packaging details, and complete cross-references to competitive type numbers. There are also features on surface mount packaging, the new RS485 line standards, and CMOS linear technology.

Industry Standard Line Circuits concentrates on applications requirements of international standards such as RS232, RS422, RS423, RS484, and IEEE488. It summarizes the differences in requirements between the industry standards, particularly highlighting the new RS485 multipoint standard.

These brochures are available on request from TI sales offices and distributors.

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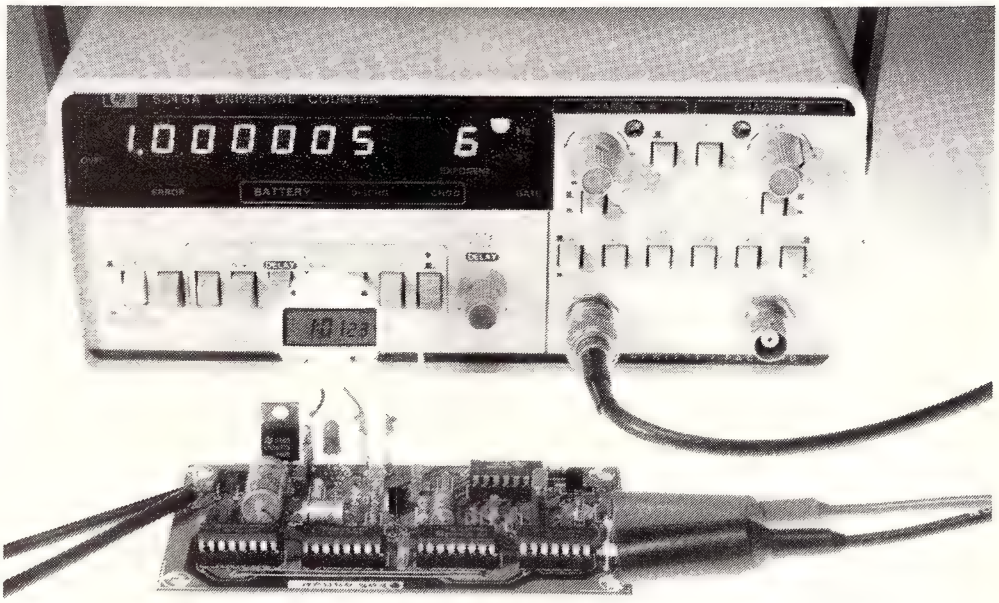


G E Dunning

A frequency standard is a stable and precise oscillator that is calibrated against national or international reference frequencies which are often broadcast as time signals throughout the day; in many countries, such reference signals are also available over the telephone. These reference frequencies deviate by not more than 1 second per 3170 years. The clock used in the SI definition of the second is 100 times better still! A frequency standard is used, for instance, to check the calibration accuracy of various measuring instruments. For this purpose, an accuracy of about 1 p.p.m. is normally perfectly adequate.

frequency standard

A quartz-controlled digital watch, synchronized to a radio or telephone reference time signal over a period of time, is a convenient and inexpensive basis for a frequency standard. Such a watch commonly deviates not more than 1...2 seconds per month from true time, which is an accuracy of better than 1 p.p.m.
The quartz-crystal oscillator in a digital watch has a frequency of 32.768 kHz, which is divided by 2^{10} (=1024) to obtain a 32 Hz signal for maintaining the LCD (liquid crystal display). It is not possible to tap the basic oscillator frequency without upsetting its accuracy, but the 32 Hz signal may be tapped with impunity.

Functional details

Phase-locked loop. The operation of the frequency standard is illustrated in the functional diagram of Figure 1. The circuit receives a reference signal of 32 Hz from the digital watch, and this is compared in a phase detector with a signal derived from a VCO (voltage-controlled oscillator). If the VCO signal differs from the reference signal in phase or frequency, the phase detector generates an error signal, which is fed to the VCO via a low-pass filter. In this way, the VCO becomes a self-adjusting stage that provides a stable and accurate 16 MHz signal. This signal is divided by 16 and 16×10^6 to give output frequencies of 1 MHz and 1 Hz respectively.
Note that the 1 MHz signal has a 32 Hz ripple caused by the control signal to the VCO. However, the peak value of this ripple is so small that it will hardly ever be noticeable in practice.

Voltage-controlled oscillator. The oscillator formed by gates N_1 and N_2 in Figure 2 is a conventional crystal-operated circuit. If, however, a variable reactor, here formed by a VMOSFET Type BS170, is added, it becomes possible to vary the frequency with the control voltage provided by the phase detector via R_7. The use of a MOSFET as varactor (acronym of **var**iable re**actor**), instead of the more usual semiconductor diode, has the advantage of a relatively large change in capacitance — from 80 pF to 30 pF — for a voltage swing of 0 V to 2.5 V (see Figure 6). The maximum control voltage of 2.5 V arises when the output signal of the phase detector is symmetrical. These values enable the output frequency of the VCO to be varied from 15.999 to 16.000 MHz. The correlation between the output frequency and the control voltage is shown in Figure 7. The characteristic shows that the wanted frequency of 16 MHz is obtained with a control voltage of 1.2 V.

Phase detector. Correct operation of the frequency standard depends essentially on the proper functioning of phase detector N_3-N_4 (see Figure 2). Assuming that the inputs to N_4 are square wave signals, the duty factor, by definition, is 1:1. Slight variations in the duty factor will result from small differences in phase between the two inputs, and this will cause a change in the output voltage of the detector. The control voltage for the VCO is derived from this output: the correlation between the control voltage and the phase differ-

1

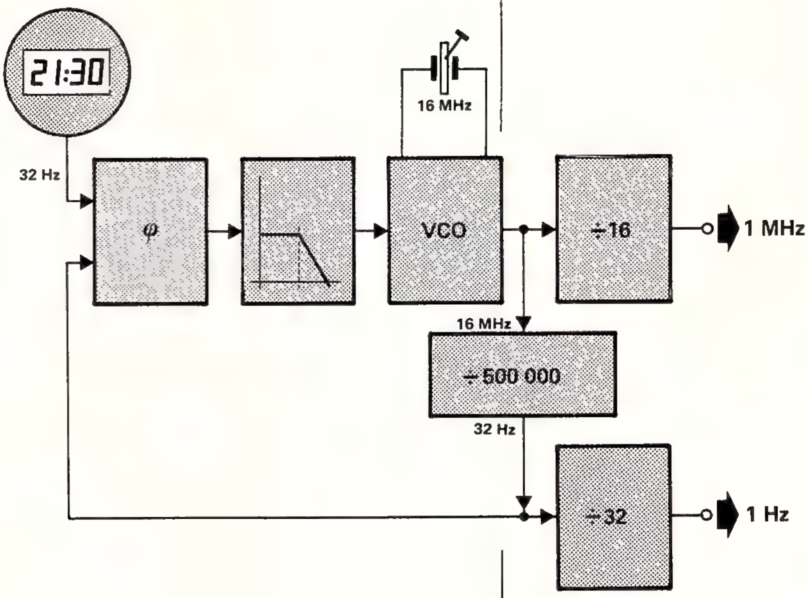


Figure 1. Functional diagram of the frequency standard.

2

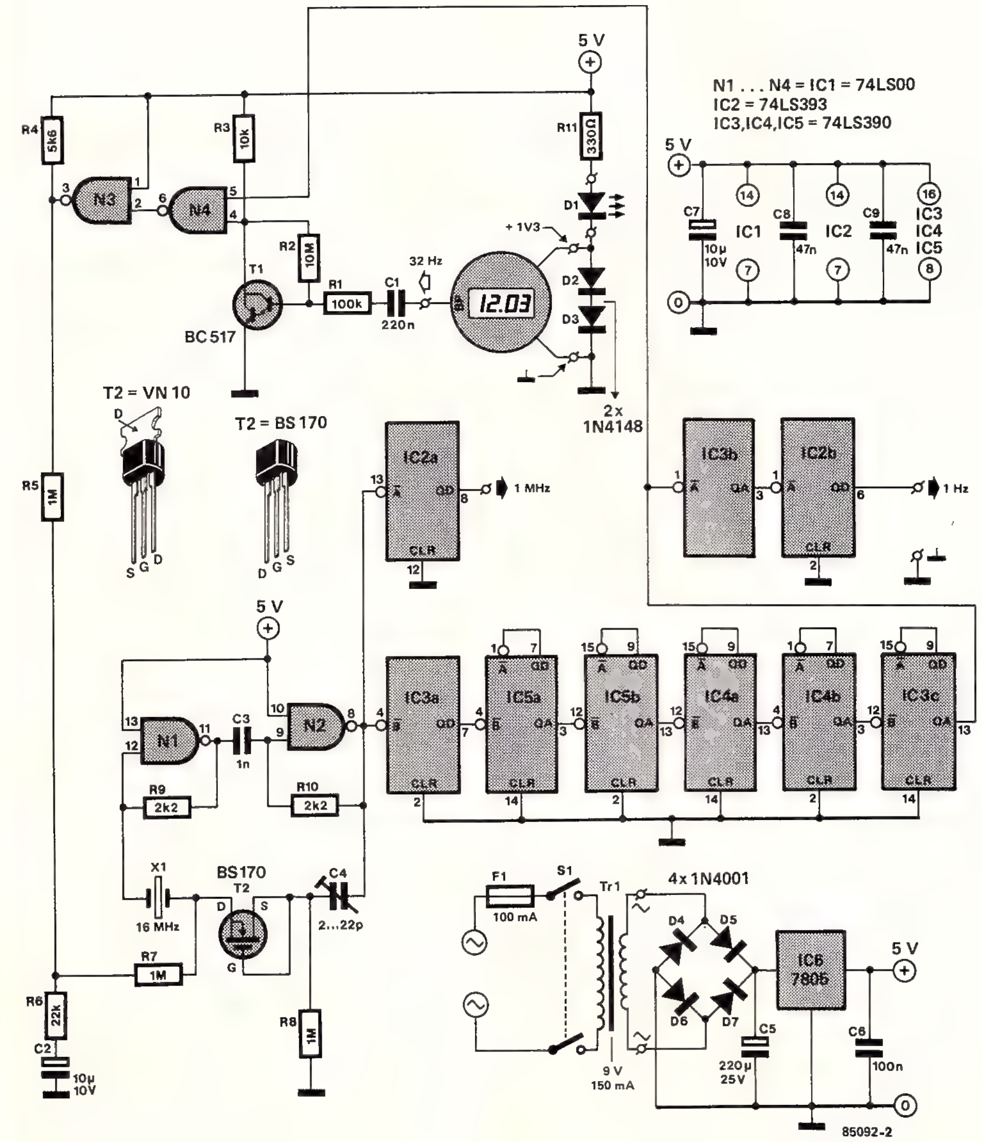


Figure 2. Circuit diagram of the frequency standard.

3

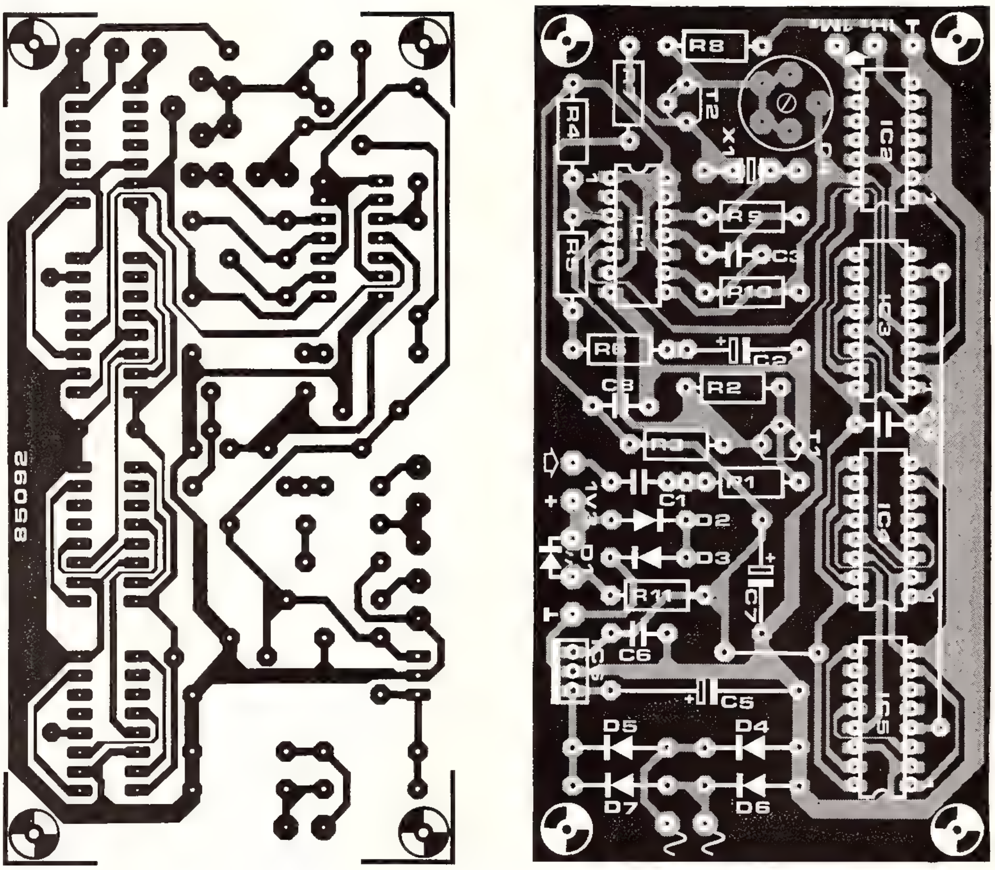


Figure 3. Printed-circuit board for the frequency standard.

ence at the inputs of the detector is shown in Figure 8. The circled cross indicates an operating point where the frequency of the signal at pin 5 of N_4 is a little lower than that at pin 4. This means that the phase difference between the two signals becomes larger, and this causes the operating point to slowly move towards the *x*-axis. This does not mean more stable operation, however! When the operating point has reached the turn-over point at 180°, the control voltage to the VCO begins to rise. This causes the VCO frequency, and consequently that at pin 5 of N_4, to increase. The widening phase difference is then slowed down until an equilibrium is reached, and this happens when the frequencies at pin 4 and pin 5 of N_4 are equal. The phase-locked loop is then operating correctly.

If the output frequency of the VCO drops a little due to a temperature variation, the phase difference widens again. The control voltage increases, and the VCO output frequency rises to its correct value.

Figure 7 shows that the maximum possible frequency correction is ± 1000 Hz. After division by 500 000, this becomes ± 0.002 Hz, which means that it takes the VCO a maximum of $1/0.002 = 500$ s to correct itself.

Circuit details

The 32 Hz signal from the watch is fed to the phase detector, consisting of gates N_3 and N_4, via MOSFET amplifier T_1. The error signal from the detector is applied to the voltage-controlled oscillator, composed of MOSFET T_2 and gates N_1 and N_2, via low-pass filter R_5-R_6-C_2. MOSFET T_2 functions as a varactor, so that the oscillator frequency varies with the control voltage as mentioned. The output of the VCO is divided by 16 in IC_{2a}, and by 16×10^6 in the chain $IC_{3a} \ldots IC_{2b}$.

The power supply is of conventional configuration: transformer, rectifier, smoothing capacitor, and voltage regulator. If desired, the battery in the watch may be replaced by a direct supply via stabilizing diodes D_2 and D_3.

Construction and calibration

The frequency standard has been designed for construction on the printed-circuit board in Figure 3. Voltage regulator IC_6 does not need a heat sink. Once the board has been completed, connect the negative supply (earth) line to the watch. If the watch battery is replaced by a direct power supply, the +5 V line should now also be connected via R_{11} and D_1. The trickiest part is to solder (with a very fine soldering tip!) a length of wire to the track of the PCB in the watch at which the back plate signal is present. This is normally at the top left (seen from the front of the board) of the LCD display. It is necessary to use an oscilloscope to determine which track carries the back plate signal. This signal has either a single- or double-step rectangular waveform with a period of 1/32 s as shown in Figure 4. The watch should be set for seconds display, which makes it easier to distinguish between the constant back plate signal

Parts list

Resistors:

R_1 = 100 k
R_2 = 10 M
R_3 = 10 k
R_4 = 5k6
R_5;R_7;R_8 = 1 M
R_6 = 22 k
R_9;R_{10} = 2k2
R_{11} = 330 Ω

Capacitors:

C_1 = 220 n
C_2;C_7 = 10 μ; 10 V
C_3 = 1 n
C_4 = 2...22 p; variable
C_5 = 220 μ; 25 V
C_6 = 100 n
C_8;C_9 = 47 n

Semiconductors:

D_1 = LED; as required
D_2;D_3 = 1N4148
D_4;D_7 = 1N4001
T_1 = BC517
T_2 = BS170; VN10KE; VN10LE
IC_1 = 74LS00
IC_2 = 74LS393
IC_3;IC_4;IC_5 = 74LS390
IC_6 = 7805

Miscellaneous:

X_1 = quartz crystal: 16 MHz
F_1 = miniature fuse; 100 mA; delayed action; with carrier
Tr_1 = mains transformer; secondary 9 V; 150 mA
S_1 = DPST mains switch
quartz digital watch
5092

4

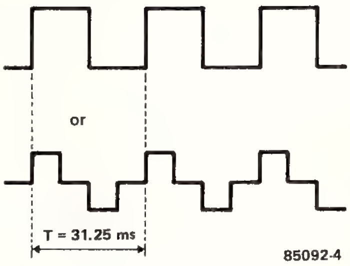


Figure 4. Back plate signal in a digital watch.

5

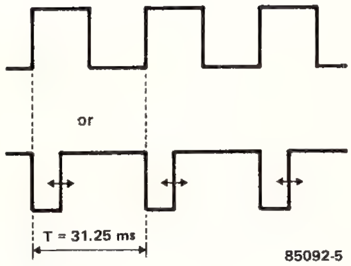


Figure 5. Signal at the junction of R_2 and R_3.

and the varying segment signal. Once the watch is connected to the main board, the signal at the junction of R_2 and R_3 should be as illustrated in Figure 5.
Connect an analogue voltmeter, set to the 3 V DC range, to the junction of R_4 and R_5. This instrument should have an input impedance of not less than 20 kΩ/V. When the standard is switched on, the pointer of the voltmeter will move to and fro at a speed which is dependent on the setting of capacitor C_4. Wait till it indicates 1.2 V or 1.8 V, depending on whether the waveform at junction R_2-R_3 is symmetrical or asymmetrical respectively — see Figure 5. Once this situation has been reached, quickly adjust C_4 until the meter reading is constant or changes only very slowly, i.e., less than 0.1 V per 10 seconds. The phase-locked loop is then calibrated. It may happen that the voltmeter indicates 0 V or 2.5 V after a few minutes and then returns to 1.2 V or 1.8 V, as the case may be, after which it remains stable. This is perfectly normal as explained under *phase detector*.

Application

Both the 1 Hz and 1 MHz outputs are, in the first instance, intended for the calibration of a frequency counter or similar instrument: it has, for example, been used to calibrate the *µP-controlled frequency meter* featured in the January 1985 issue of *elektor electronics*.
The 1 Hz signal may, of course, also be used as the clock for time pieces, which then hardly ever need to be adjusted. ◼

6

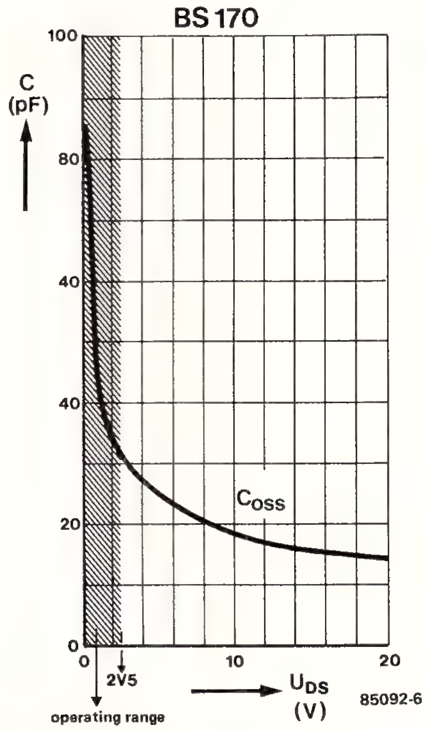


Figure 6. Capacitance vs drain-source voltage in a BS170.

7

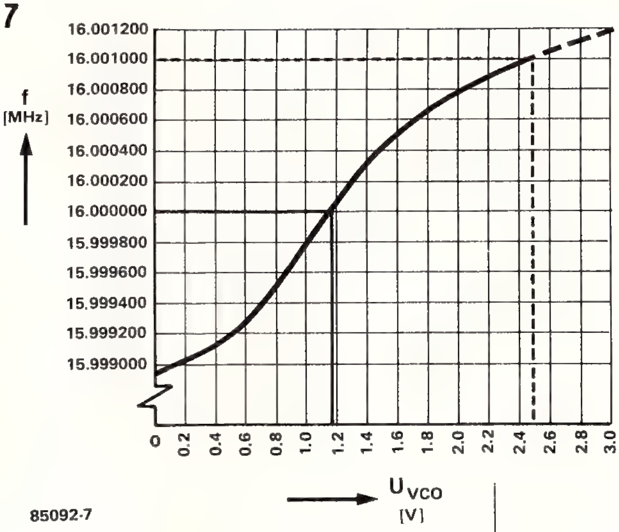


Figure 7. Frequency vs control voltage characteristic.

8

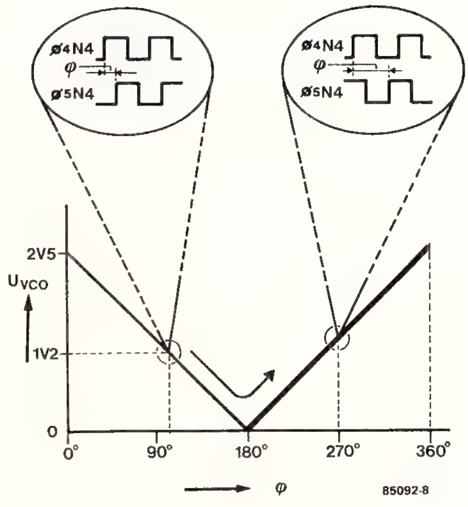


Figure 8. Control voltage vs phase difference characteristic.

BAKERS DOZEN PARCELS

All the parcels listed below are brand new components. Price per parcel is £1.00, but if you order 12 you get one extra free.

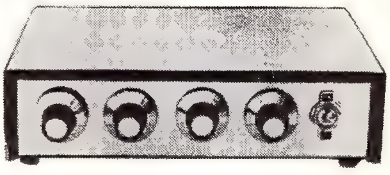
1 - 5 13 amp ring main junction boxes
2 - 5 13 amp ring main spur boxes
3 25 13 amp fuses for ring mains
4 5 surface mounting switches suitable insulated for mains voltage
5 - 3 flush electrical switches intermediate type, will also replace 1 or 2 way switches
6 5 in flex line switches
7 - 4 in flex line switches with neons
8 - 2 80 watt brass cased elements
9 - 2 mains transformers with 6v 1a secondaries
10 2 mains transformers with 12v ½a secondaries
11 1 extension speaker cabinet for 6½" speaker
12 5 octal bases for relays or valves
13 12 glass reed switches
14 4 OCP 70 photo transistors
15 - 25 assorted germanium transistors OC45 etc
16 4 tape heads, 2 record, 2 erase
17 2 ultra sonic transmitters and 2 ditto receivers
18 2 15000 mfd computer grade electrolics
19 2 light dependent resistors similar ORP12
20 5 diff micro switches
21 2 mains interference suppressors
22 2 25 watt crossover units
23 - 1 40 watt 3 way crossover unit
24 - 250 various screws and self tappers
25 - 1 of each wafer switches — 6p 2 way; 4p 3 way; 2p 6 way; 1p 12 way
26 2 tape deck counters
27 1 6 digit counter 12v
28 1 6 digit counter mains voltage
29 1 BOAC in flight stereo unit (second hand)
30 - 2 Nicad battery chargers
31 1 key switch with key
32 2 humidity switches
33 - 2 aerosol cans of ICI Dry Lubricant
34 96 × 1 metre lengths colour-coded connecting wires
35 - 4 battery operated model motors
36 2 pair spaced 2 gang tuning condensors
37 2 solid diaelectric 2 gang tuning condensors
38 - 10 compression trimmers
39 Long and Medium wave tuner kit
40 4 × 465 KC IF transformers
41 - 8 Rocker Switches 10 amp Mains SPST
42 6 Rocker Switches 10 amp Mains SPDT
43 5 Rocker Switches 10 amp SP DT Centre Off
44 - 4 Rocker Switches 10 amp DPDT
45 - 1 24 hour time switch mains operated (secondhand)
46 1 6 hour clockwork timeswitch
47 - 2 lever switches 4 pole changeover up and ditto down
48 2 6v operated reed switch relays
49 10 neon valves — make good night lights
50 - 2 × 12v DC or 24V AC 4C0 relays
51 1 × 12v 2C 0 very sensitive relay
52 1 × 12v 4C 0 relay
53 - 2 mains operated relays 3 × 8 amp changeovers (secondhand)
54 - 10 rows of 32 gold plated IC sockets (total 320 sockets)
55 - 1 locking mechanism with 2 keys
56 - Miniature Uniselector with circuit for electric jigsaw puzzle
57 - 5 Dolls' House switches
58 2 telephone hand sets incorporating ear piece & mike (s/hand)
59 - 2 flat solenoids ideal to make current transformer etc.
60 - 5 ferrite rods 4" × 5/16" diameter aerials
61 4 ferrite slab aerials with L & M wave coils
62 - 4 200 earpieces
63 - 1 Mullard Thyristor trigger module
64 10 assorted knobs ¼ spindles
65 - 5 different thermostats, mainly bi-metal
66 magnetic brake — stops rotation instantly
67 - three levels of low pressure switch
68 - heavy duty 4 pole conductor — 24v coil
69 - 2 25 watt pots 8 ohm
70 - 2 25 watt pots 1000 ohm
71 4 wire wound pots — 18, 33, 50, 100 ohm
72 6 assorted slider pots including 2 stereo
73 4 3 watt wire wound pots 50 ohm
74 50 ⅓ watt carbon film resistors — good spread, 10 values
75 20 2 watt carbon resistors
76 30 1 watt carbon resistors spread of values
77 1 time reminder adjustable 0-60 mins.
78 5 5 amp stud rectifiers, 400v
79 4 2a bridge rectifiers, 400v
80 2 10a bridge rectifiers, 30v
81 2 30a panel mounting slydlok fuses
82 - 4 porcelain fuse holders and fuses
83 1 fluorescent choke — your choice — 15, 20, 30, 40 or 65 watt
84 10 1 mains suppressor condensors
85 1 mains shaded pole motor ¾" stack
86 2 5" ali fan blades fit ¼" shaft
87 2 3" plastic fan blades fit ¼" shaft
88 mains motor suitable for above blades
89 1 mains motor with gear box 1 rev per 24 hours
90 1 mains motor with gear box 1 rev per 12 hours
91 - 2 mains motor with gear box 16 rpm
92 4 fluorescent starters for 4 - 80 watt tubes
93 4 11 pin bases for relays
94 5 B7G valve bases
95 - 4 skirted B9A valve bases
96 - 1 fridge stat
97 - 1 infra red fire element 1000 watts
98 - 1 motorised stud switch (SH)
99 5 assorted ferrite shapes
100 3 ferrite magnets
101 1 2½ hour delay switch
102 1 9v mains power supply unit
103 - 1 6v mains power supply unit
104 1 4½v mains power supply unit
105 1 5 pin plug and socket
106 2 12v vibrating reed bleepers
107 5" speakers size radio cabinet with handle
108 - 5 different multi way push switches
109 - 10 ¼" spindle type volume controls
110 - 10 slider type volume controls
111 2 musical boxes (less keys)
112 1 heating pad 200 watts mains
113 1 fm front end with tuning condensor
114 - 1 1w amplifier Mullard 1172

The AMSTRAD Stereo Tuner

This ready assembled unit is the ideal tuner for a music centre or an amplifier, it can also be quickly made into a personal stereo radio — easy to carry about and which will give you superb reception.

Other uses are as a "get you to sleep radio", you could even take it with you to use in the lounge when the rest of the family want to view programmes in which you are not interested. You can listen to some music instead

Some of the features are: long wave band 115-270 KHz, medium wave band 525 — 1650 KHz, FM band 87 — 108 MHz, mono, stereo & AFC switchable, fully assembled and fully aligned. Full wiring up data showing you how to connect to amplifier or headphone and details of suitable FM aerial (note ferrite rod aerial is included for medium and long wave bands). All made up on very compact board Offered at a fraction of its cost: **only £6.00**



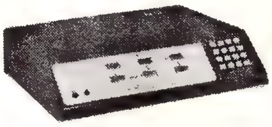
SOUND TO LIGHT UNIT

Complete kit of parts for a three channel sound to light unit controlling over 2000 watt of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special price is **£14,95** in kit form or **£25.00** assembled and tested.

CAR STARTER/CHARGER KIT Flat Battery! Don't worry you will start your car in a few minutes with this unit - 250 watt transformer 20 amp rectifiers, case and all parts with data £16.50 transformer only £12.50.

4/5A BATTERY CHARGER Transformer and rectifier £3.95 & £1 post, 3 kits £12 post paid.

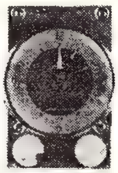
PRESTEL UNITS



These are brand new and we understand tested, came with manufacturer's guarantee now void as the manufacturer no longer trades. These originally sold for over £150. We offer them complete, except for 7 plug in i.c.'s and price is only £14.95 (less than the value of the modem included).

STABILISED POWER SUPPLY (Mains Input)

By LAMDA (USA) — Ideal for computer add-ons, d.c. output. Regulated for line volts and load current. Voltage regulation .1% with input variations up to 20% — load regulation 1% from no load to full load — or full load to no load. Complete in heavy duty case — Models available: 5v — 9A **£23**
£13.25. 15v — 1,2A £13,25. 24v — 2A **£23**.



25A ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you wake — switch on lights to ward off intruders — have a warm house to come home to. You can do all these and more. By a famous maker with 25 amp on/off switch. Independent 60 minute memory jogger. A beautiful unit at **£2.50**.

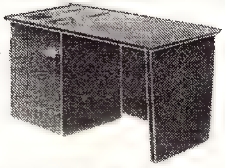
THIS MONTH'S SNIP

TOP OF THE POPS LIGHTING if you use our disco switch

These have 12 × 10 amp changeover switches each rated at 10 amps so a whole street could easily be lit with one. Switches adjustable and could be set to give a running light, random flashes, etc etc. 230 volts main operation. Brand new, made by Honeywell. Offered at approximately one third of cost

ONLY £6.90

COMPUTER DESKS



Again available · Computer desks — size approx 4' x 2' x 2'6" high formica covered, cost over £100 each. Our price only from £9.50 — you must collect — hundreds supplied to schools.

50 THINGS YOU CAN MAKE

Things you can make include Multi range meter, Low ohms tester, A.C. amps meter, Alarm clock, Soldering iron minder, Two way telephone, Memory jogger, Live line tester, Continuity checker, etc. etc., and you will still have hundreds of parts for future projects. Our 10Kg parcel contains not less than 1,000 items - panel meters, timers, thermal trips, relays, switches, motors, drills, taps, and dies, tools, thermostats, coils, condensers, resistors, neons, earphone/microphones, nicad charger, power unit, 90% are unused componants.

YOURS FOR ONLY £11.50 plus £3.00 post.

REVERSIBLE MOTOR WITH CONTROL GEAR

Made by the famous Framco Company this is a very robust motor size approximately 7½" long, 3½" dia. 3/8" shaft Tremendously powerful motor, almost impossible to stop. Ideal for operating stage curtains, sliding doors, ventilators etc., even garage doors if adequately counter-balanced. We offer the motor complete with control gear as follows

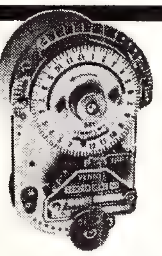
1 Framco motor with gear box
1 manual reversing & on/off switch
1 push to start switch
2 limit stop switches
1 circuit diag. of connections

£19.50 plus postage £2.50

IONISER KIT

Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder — a complete mains operated kit, case included.

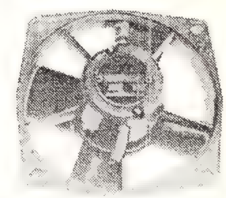
£11.95 plus £2.00 post.



VENNER TIME SWITCH

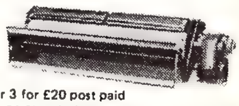
Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2.95**. without case, metal case - **£2.95**, adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/offs per 24 hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is **£2.30**.
Ex-Electricity Board.
Guaranteed 12 months.

EXTRACTOR FANS — MAINS OPERATED



Woods extractor.
5" – £5.75, Post £1 25.
6" – £6.95, Post £1.25.
5" Plannair extractor £6.50. Post £1.25.
4"x 4" Muffin 115v. £4.50. 230v. £5:75. Post 75p.
All the above ex-computer, those below are unused.
4" x 4" £8.50. Post 75p.
9" American made £11.50. post £2.00.
Tangential Blower 10x3 air outlet, dual speed £4.60. Post £1.50.

TANGENTIAL BLOW HEATER



by British Solartron, as used in best blow heaters. **3Kw £6.95** complete with 'cold' 'half' and 'full' heat switch, safety cut out and connection diagram.

Please add post £1.50 for 1 or 3 for £20 post paid

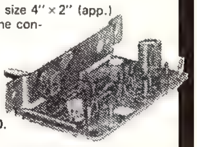
2.5 Kw KIT Still available: **£4.95 + £1.50 post.** or have 3 for £16 post paid

ROCKER SWITCHES Standard size fit 11.5 x 28 mm cut out. Single pole on/off — 15p each 1000 for £75. Single pole changeover 20p each — 1000 for £100. Single pole changeover with centre off — 25p each — 1000 for £125. Single pole on/off with neon — 36p — 1000 for £180.

ROCKER SWITCH DP/DT 15 amp 250 volts suitable for motor reversing etc. — 46p — 100 for £34.50, 1000 for £230.

MICRO SWITCHES V3 type all 250 10 amp SpST 20p 1000 — £100 Spdt 30p 1000 — £150, very low tongue Spdt 40p 1000 for £200.

MINI MONO AMP on p.c.b., size 4" × 2" (app.)



Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of £1.15 each, or 10 for £10.00.

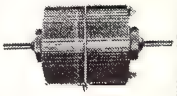
WALL MOUNTING ROOM THERMOSTAT

By Danfoss has a really pretty two tone grey case with circular white scale and dial. Setting temperature from 0 – 30 c — 13 amp 250v contacts. Price £4.60. — 10 for £40.

MINIATURE WAFER SWITCHES

2 pole, 2 way – 4 pole, 2 way – 3 pole, 3 way – 4 pole, 3 way – 2 pole, 4 way – 3 pole, 4 way – 2 pole, 6 way – 1 pole, 12 way.
All at 25p each or 10 for £2.00

12 volt MOTOR BY SMITHS



Made for use in cars, etc. these are very powerful and easily reversible. Size 3½" long by 3" dia. They have a good length of ¼" spindle —
Price £3.45.
Ditto, but double ended **£4.25.**

MAINS MOTORS

We have very large stocks of motors from 2 watts to ¼ hp. Most at a price well below cost, let us know your requirements.

OTHER POPULAR PROJECTS

R C Bridge Kit	£9.95
3 Channel Sound to Light – with fully prepared metal case	£14.95
Big Ear, listen through walls	£9.50
Silent sentinel Ultra Sonic Transmitter and receiver	£9.50
Car Light 'left on' alarm	£3.50
Secret switch — fools friends and enemies alike	£1.95
3 – 30v Variable Power Supply	£13.80
2 Short & Medium wave Crystal Radio	£3.99
3v to 16v Mains Power Supply Kit	£1.95
Radio stethoscope — fault finding aid	£4.80
Mug stop — emits piercing squark	£2.50
Morse Trainer – complete with key	£2.99
Drill control kit	£3.95
Interrupted beam kit	£2.50
Transmitter surveillance kit	£2.30
Radio Mike	£6.90
F M receiver kit – for surveillance or normal F M	£3.50
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Shop open 9.00 — 5.30, Mon to Fri, not Saturday.

switchboard

WANTED: Circuit diagram for BBC or Acorn Electron or similar. Also wish to contact computer buffs in London area. Chris Hunter, Flat E, 151 Grays Inn Road, London WC1.

TELEQUIPMENT D61 Oscilloscope, twin beam, X10 Probe, little used. £120 o.n.o. D. Callender, 17 Badger Way, Banbury, Oxon. Tel. (0295) 53475.

OSCILLOSCOPE, Tek. 544 Dual-trace, 50MHz, good condition, £165. Semiconductor- Curve tracer, £65. AF Spectrum Analyzer, £210. T.J.L. Haley, tel. 01 868 4221.

S100 6 SLOT 19" Rack & Case, £50. Philips Mini Digital Cassette Recorder, Controller & Manuals, £50. 94 way ASII Keyboard, £25. Piers Cherryl, 2 Shirelake Close, Oxford OX1 1SN. Tel. 0865 250274.

WANTED: Technical Manual for Pertec Models 81/82 Video Terminals, any information at all please. Norman Henry Pierce, 92, Railway Road, Rock Ferry, Birkenhead, Merseyside L42 2BQ.

WANTED: Information and/or circuit diagram for Airmec Radivet Type 211. H.L. Earnshaw, 58 Prices Lane, Reigate, Surrey RH2 8AY. Tel. Reigate 21480.

WANTED: User's Manual + Circuit diagrams for Nat. Semiconductor BLC 8221/8201 SD Floppy Computer PCBs. P. Walsh, 4 Stopford Street, Edgeley, Stockport SK3 9HE. Tel. 061 429 6864 (evenings).

HELP! How can I convert a TV to RGB input? Would be very grateful for a telephone call on 0205 67208 — ask for Gary.

WANTED: Information on Crypton Motorscope Major Model BDX17 and on Brimar Tube D21/106H. B.D. O'Gorman, 15 Stafford Road, Caldicot, Gwent NP6 4DE.

Z8 TBPDS and PSU needed for surgical research project. No funding so can't afford a new one. Dr. A.M.S. Brown, 53, Ivy Lane, Headington, Oxford OX3 9DT. Tel. (0865) 65164.

WANTED: One AY5-1224. Please phone 0344 884090.

TELEVIDEO TS-801 Technical/ Operator's Manuals required. Phone Sheffield (0742) 334370 any time.

DIGITAL AVO, £25. No offers. Phone 01 554 2913, 6 to 8 p.m.

SURPLUS MEMORY CHIPS; 6116 £3; 4164 £2.50; 4864 £2.50. Also some 2764, 6264. Include 50p postage. M. Bright, 36 Freckleton Drive, Bury, Lancs. BL8 2JA.

WISH TO GET in contact with enthusiasts interested in computers (hardware), London area only please. Chris Hunter, Flat E, 151 Grays Inn Road, London WC1.

I AM AN ELECTRONIC ENGINEER, looking for professional penfriends from all over the world, to swap various information. Please write to: M.A. Kavehmanesh, P.O. Box 11365/ 7619, Tehran, Iran.

WANTED: Circuit Diagram & chips for TI58 & 59 Calculators. Tel. 0227 262378.

WANTED: National Pressure Transducers 20F-LX0503A or LX050XXA Series DAFL25M80. J.E. Simmons, 1397 Whangaparaoa Road, Whangaparaoa, New Zealand.

PRINTER, TI Silent 700 Type. Believed to be in working order. No data. £30 o.n.o. Tel. (day) 0234 223202, Frank.

WANTED: Book entitled 'Teletext and Viewdata' by Steve Money. Please state price, inc. postage. Mr N. Dobson, 19, Romney Drive, Carrville, Durham DH1 1LS.

WILL PAY FOR information on Marconi B/W Studio TV Camera as seen on Grandstand. Please help. Tel. 01 749 3123, daytime.

10M 25W RAINBOW Ribbon Cable, £6. 100 IC Skts, £5.50, plus other oddments to clear my garage (VDU, PSU's, etc.). Mr J. Rudge, 20 Blackthorne Close, Solihull, West Midlands B91 1PF. Tel. (021) 705 8459.

WANTED: Heathkit Transistor Tester, S/H. Mr F. Cosgrove, 59 Fenton Road, Bournemouth. Tel. 0202 432973.

ELEKTOR issues wanted — nos. 7, 37, 53, 86 and 87/88. Tel. 0602 384098.

URGENTLY REQUIRED to complete Junior project: DOS 65DV3.2N/3.3. Fair price. J.S. Barry, 29 High Street, Warmley, Bristol BS15 4NE. Tel. 0272 600323.

ELEKTOR Z80A CPU/VDU Boards, fully fitted, unused. IC's 6116/2732 not included. Used keyboard, etc. £75 or swap ham gear. Tel. 061 437 7899, South Manchester.

SURPLUS NEW ITEMS: 2114, 2102, 4116, £5 for 8. 8×4164, £17. 5×2532, £10. 6845, 8027, £2. 8748 Comp. £15. 10 × Scalectric Motors, £5. Mr S.A. Withey, 118, Heritage Park, St. Mellows, Cardiff, S. Glamorgan. Tel. 0222 797956.

WANTED: Loan or purchase for Trio Tuner Model KT-3500. M. Norman, 1, Sydenham Mews, Putland Road, Bray, Co. Wicklow, Ireland.

PRIVATE SALE: ETI, HE, PW, EE, R&EC, TV and Elektor mags. SAE for lists — 465 Blackstock Road, Rollestone, Sheffield S14 1LB. (Michael).

GOULD OSI200 25MHz Scope, Dual Trace, good condition, £140. Mr Andrew Burns, tel. Romford 42627, evenings.

LVL 5¼" 100K Disc Drive in twin case, £90. DFS for BBC Micro, £60. Both items hardly used. Phone Adam: 04484 3225.

VALVE AZ1 required for old Philips Valve Radio Receiver — anyone able to help me to find one please write to: J.P. Houdet, 104 Clarendon Road, Durban North 4051, South Africa.

HITACHI 8" B/W Monitor, £25. Vero 19" 34 Eurocard Rack + bits, new, £18. 7126 + 3½ LCD, new, £8.50. Tel. 01 961 6658.

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elektor electronics
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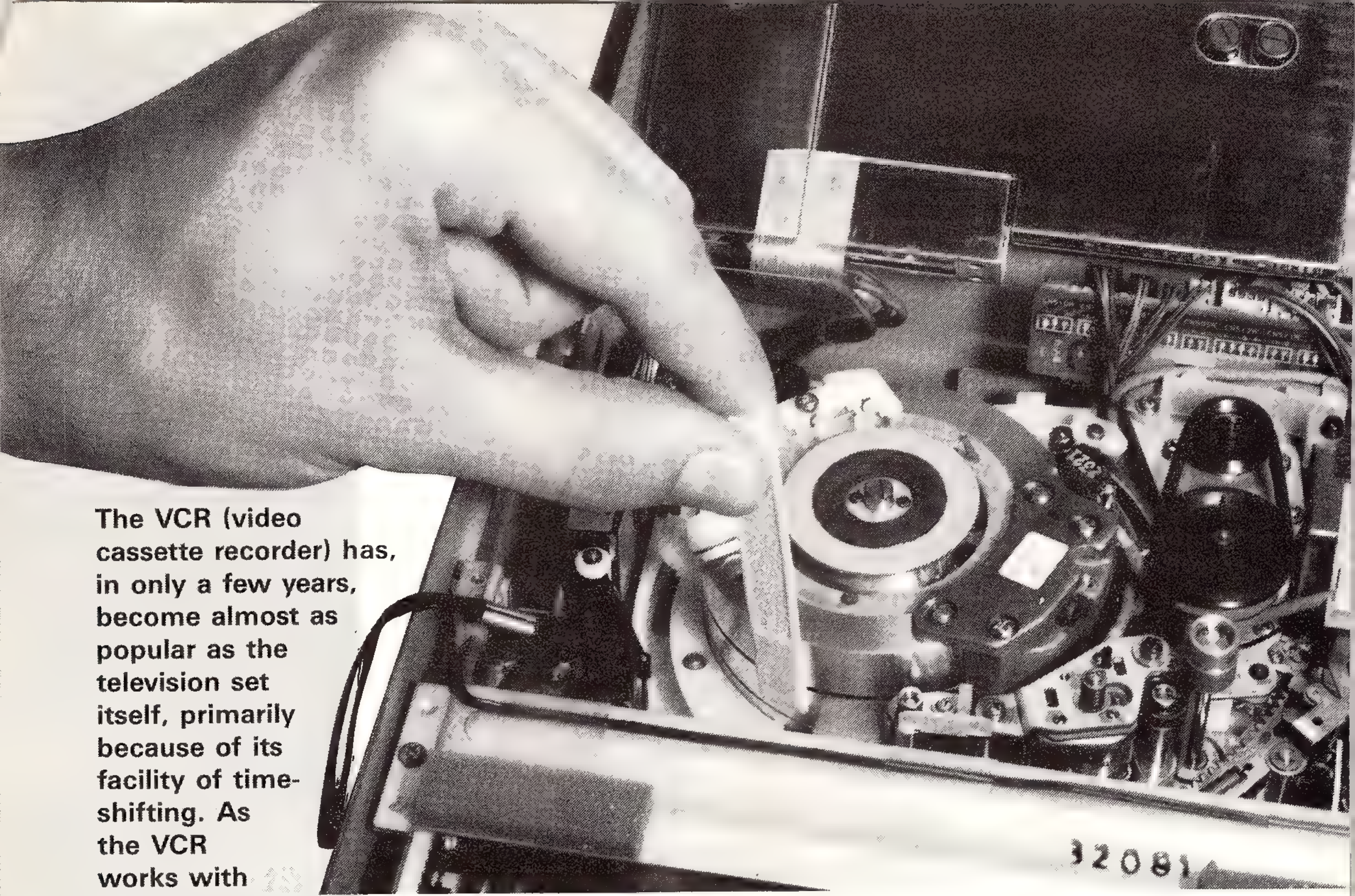
September 1985



The VCR (video cassette recorder) has, in only a few years, become almost as popular as the television set itself, primarily because of its facility of time-shifting. As the VCR works with magnetic tape, the mechanism of the machine will become dirty after a time, in the same way as in a sound cassette recorder. Regular cleaning of particularly the recording and playback heads is, therefore, essential to ensure optimum picture and sound quality, and to minimize wear of these heads. Unfortunately, the heads are very sensitive precision parts, which do not stand up to a brushing with some alcohol. And there are other aspects of the VCR mechanism that require particular attention. This article aims at explaining what you can do yourself, and what should better be left to properly trained service engineers.

cleaning video recorders

H. Baggen

Although much has been written about the cleaning of a video recorder, there is little that makes the operation clear in a practical way. Cleaning tapes as well as complete cleaning outfits for VCRs have come onto the market over the past few years, but most appear to be almost completely ineffective.

Distributors, importers, and manufacturers alike are generally of the opinion that VCRs should only be cleaned in their service department. No doubt, this feeling is based on the assumption that the owner of the recorder knows little or nothing of electronic and mechanical engineering. Yet, with some technical insight, dexterity, and care, it is possible to clean your own VCR and save the not inconsiderable charge made by professional service departments for this operation. But care is the word, because video heads are very easily damaged, and replacing them is, of course, a great deal more expensive than having them cleaned!

Where does the dirt come from?

Dirt in the video recorder is an accumulation of dust and microscopically small particles of iron oxide and base material. The iron oxide is the magnetizable basic substance used for coating the base, which, incidentally, gives the finished tape its brown colour. The base material is most likely to be polyester (more correctly polyethylene terephtalate — called mylar in the USA), but may also be polyvinylchloride (PVC), or cellulose acetate.

Base particles form the largest proportion of the accumulated dirt. This is because the tape follows quite an intricate path in the machine, running along a variety of guide rollers and pinch rollers, as well as the capstan and the recording, playback, and erase heads. Although the keying (firmness of adhesion of the coating to the base) and the abrasion resistance of modern tapes are very good, minute particles are worn off over a period of time and left in the machine. Therefore, the better the tape quality, the less frequent there is a need for cleaning the heads. Dust on the tapes (which is left behind in the machine) can be minimized by storing the tapes in closed boxes. The recorder itself should also be placed in as dust-free a position as possible. Note that the television receiver because of the strong static field around the picture tube is a dust trap.

When is cleaning necessary?

Even if the VCR stands in a dust-free position and high-quality tapes are used, there comes a time when the machine — and not just the heads — needs cleaning. Fortunately, the heads tend to keep themselves cleaner than other parts of the guidance because of their relatively high rotational speed. Cleaning of the VCR becomes necessary when the picture becomes "snowy" (as if a poor signal had been recorded), or the sound quality deteriorates (in which case the video heads need not be attended to).

How to clean

Before cleaning is contemplated, several important aspects of the operation should be noted.

- The video heads are extremely vulnerable; one false move or treatment can destroy them. And replacement costs are high!
- Use correct materials: no cotton buds; no cleaning spirit; no so-called cleaning tapes; no spray cans with head cleaner. The video heads should be cleaned with head cleaning sticks with a chamois leather tip, and other parts of the guidance with the same type of stick or non-fluffy tipped sticks or cloths. These sticks or cloths should be soaked in pure alcohol or cleaning spirit, which are available from good video dealers or chemists. Wearing of rubber gloves is recommended, because skin grease and perspiration contain acids which may affect certain guidance parts.
- If you have any hesitation about cleaning the VCR yourself, have the work done by an authorized dealer.

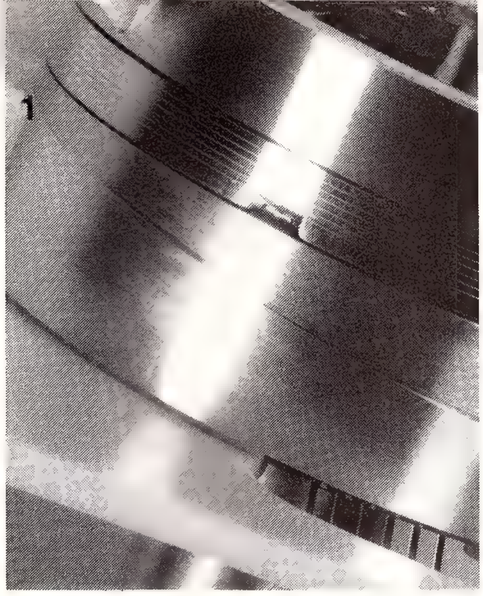

1

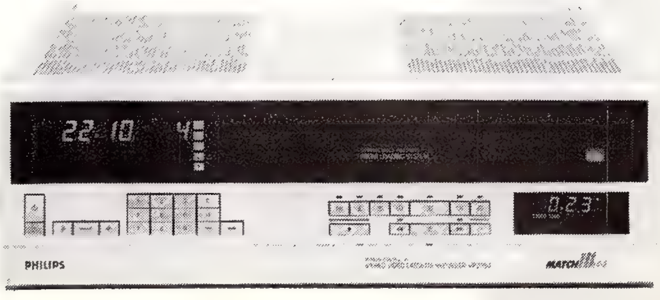
Figure 1. Everything revolves around this: the picture scanning drum with the video heads. The thin line in the hole of the drum is the video head, which rotates at 1500 rev/min.

Before cleaning can be commenced, it is essential to know the location of the various parts of the guidance system. The three current systems, VHS, Betamax, and V2000 are shown in figures 2, 3, and 4, which clearly indicate the position of the various heads and other parts. The V2000 system is either of the M-loading (= Philips), or the U-loading (= Grundig) type, as shown in figures 4a and 4b respectively. When there is no tape in the machine, guide rollers may be in a slightly different position from those shown in the figures.

First, remove the mains lead from the mains, and any cassette from the machine. Stand the recorder in a well-lit position and remove the top cover. In some older top-loading machines, it may be necessary to first remove the cassette compartment as detailed in the relevant service notes or manual. After the top cover has been removed, it is normally quite clear what else needs to be undone to gain free access to the guidance.

The following parts can then be cleaned with a chamois leather tipped stick or cloth soaked in alcohol or cleaning spirit: all normal (i.e., not video) heads, the capstan, all guide rollers, and pinch rollers (the material of which these latter rollers are made may, however, be affected by alcohol or cleaning spirit, so make sure that this is not the case before cleaning the rollers).

Next, carefully clean the outside of the picture scanning drum with a chamois-leather tipped stick. **Never touch this drum with bare hands**! Pay particular attention to the slant track at the underside of the drum, and to persistent dirt particles on the surface of the drum. **Take**



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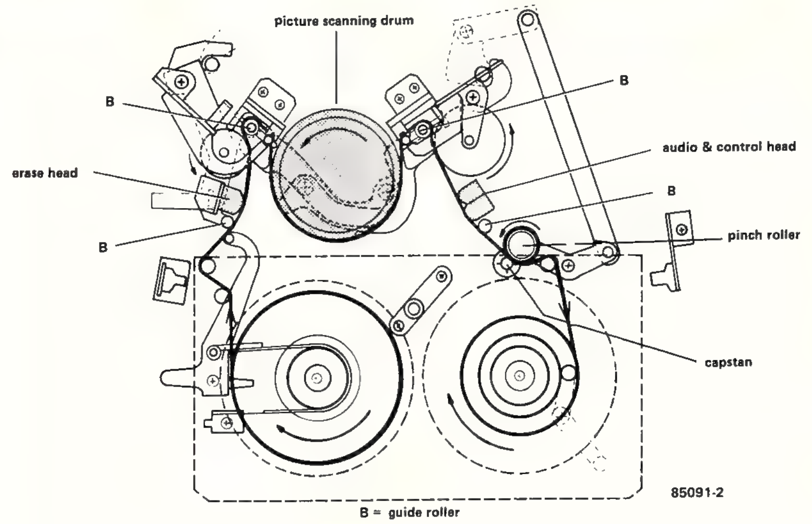

Figure 2. The guidance system of a JVC VHS recorder; that in other VHS machines is virtually identical. (Courtesy: JVC)

3

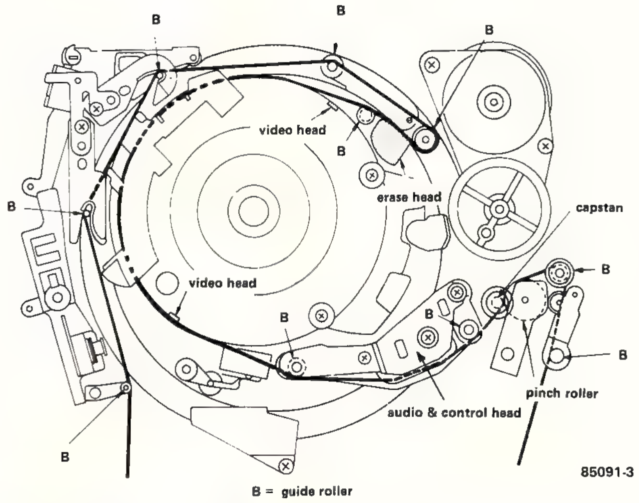

Figure 3. The guidance system in a Betamax video recorder. (Courtesy: Sony)

5

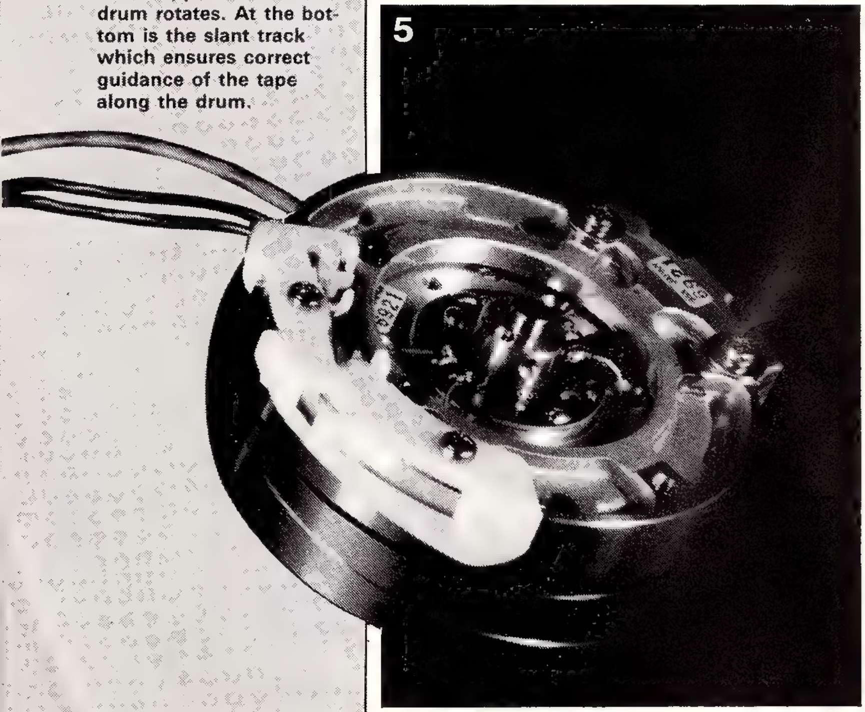

Figure 5. This photograph of a Betamax picture scanning drum shows in the centre of the drum the gap in which the heads revolve; in V2000 and VHS machines the entire upper half of the drum rotates. At the bottom is the slant track which ensures correct guidance of the tape along the drum.

great care not to touch the video heads! Take a clean chamois-leather tipped stick, soak this in alcohol, and, as shown in Figure 6, press it lightly against the gap at the circumference of the drum in which the heads rotate. Hold the stick steady, and turn each of the heads a few times by hand (rubber glove!). Often this can be done by turning the spindle of the drum at the top; this is, however, not possible with the V2000 system, because the top of the drum contains some sliding contacts and a contact bridge. **Do not, under any circumstances, loosen this bridge during cleaning!** In this type of recorder, therefore, carefully turn the top of the drum by hand (rubber gloves!). Do not touch the heads and do not move the stick vertically! One false move here could cause the head to snap off.

Take care not to displace any guidance parts during the cleaning. For instance, do not attempt to move the tape-slack take up mechanism. In short, only do what is strictly necessary and then put the covers on again.

4

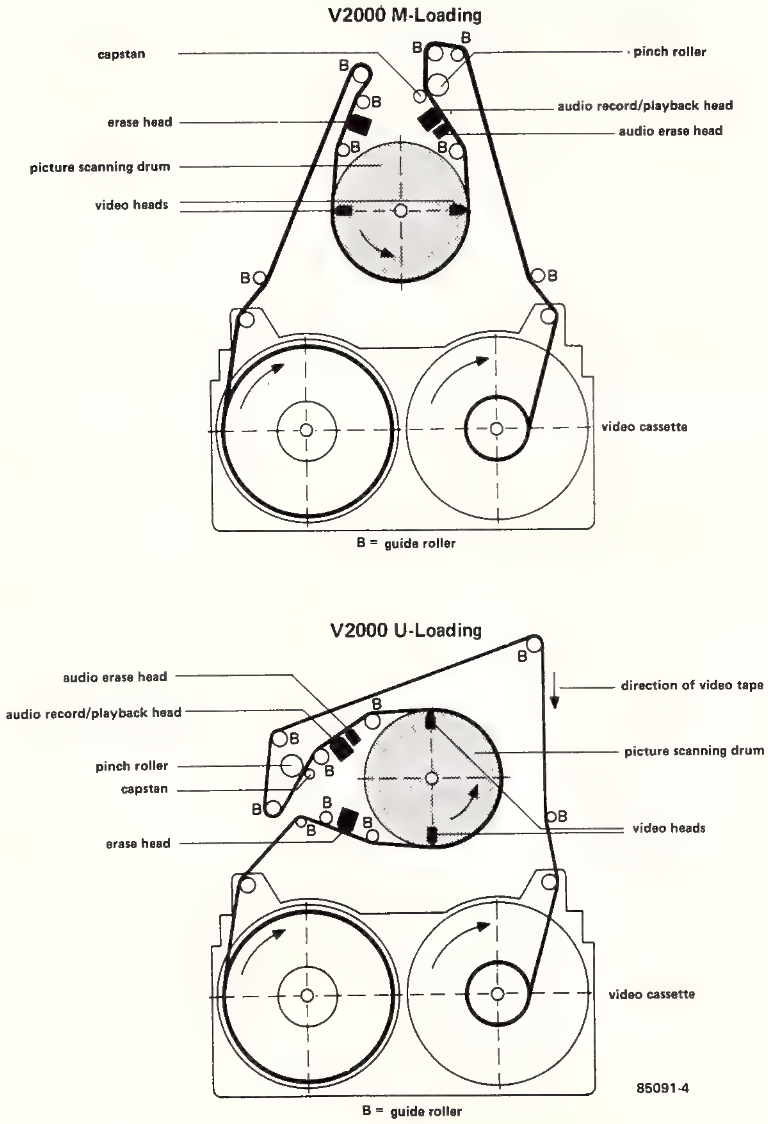

Figure 4. The guidance system in a V2000 M-loading (Philips) recorder (a), and that in a U-loading (Grundig) machine (b).

6

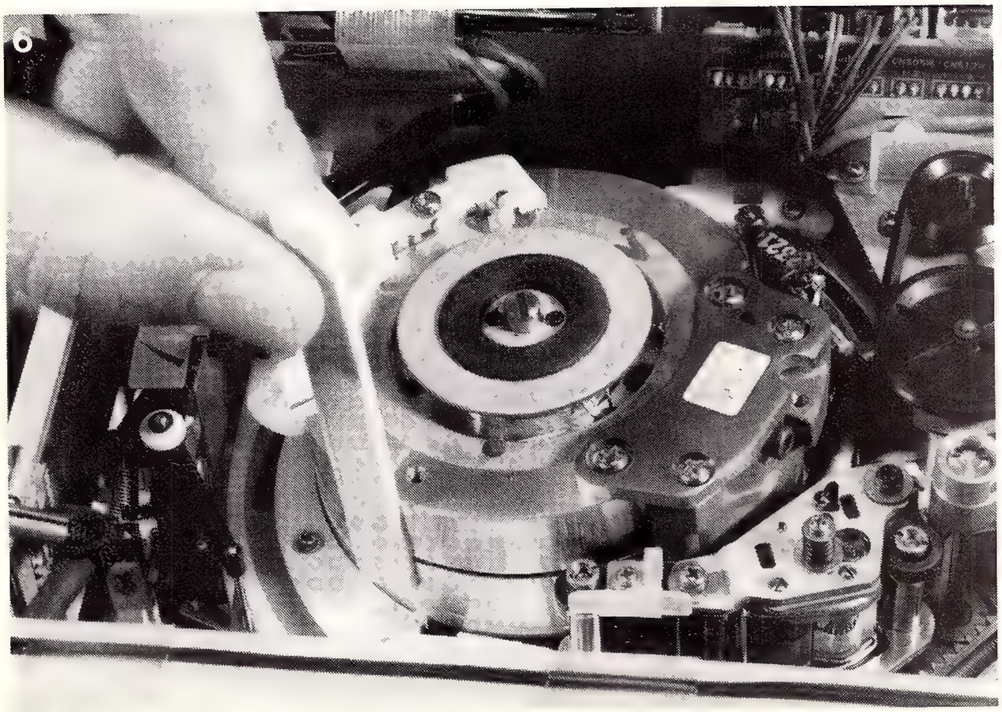

Figure 6. The critical moment; the chamois-leather tipped stick is pressed gently against the drum, after which the heads are moved by turning the disc protruding at the top of the drum by (rubber gloved) hand.

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WINDSOR GUILDFORD ST ALBANS

electronics select

Radio system signals savings on rural railways

In the far northwest of Scotland, on the single track railway that winds through magnificent mountain scenery to the Kyle of Lochalsh, the installation of electronic signalling will lead to significant improvements in the economics of rural railways. By eliminating the need for 20 signalmen and level crossing keepers on the 103 km line, the new system, known as radio electronic token block (RETB) signalling, will reduce operating costs by some £77 000 a year. This is big money for a railway that depends for most of its income on tourists during a short summer season, and will make all the difference to the line's precarious finances.

Sparsely Populated Region

Britisch Rail is pioneering the new signalling system as part of a major programme to increase traffic and cut costs on the lines running west and north from Inverness. These are routes vital to the economy of a sparsely populated region, and they absorb a hefty slice of the public service obligation subsidy British Rail receives from the government.
Installed at a cost of £415 000, and with a 30% grant from the European Community, the RETB system in practice should cover its investment within two years. In the longer term, its introduction will save British Rail the £500 000 cost of cable renewal that would have been necessary to maintain the existing signalling system.
Modern power signalling has been extended to cover many of British Rail's main lines over the past 20 years, bringing improved safety and reliability, as well as reduced costs. But shortage of investment funds has meant that lightly used rural routes have not felt the benefit of the rapid technological progress recently achieved in signalling installations. Now all this is changing, as the labour intensive mechanical signalling on such lines wears out and new economic pressures demand a reduction in the number of staff needed to operate their sparse services.
On the Kyle of Lochalsh line, RETB equipment replaces the single line key token system, which is a method of ensuring the safe passage of trains on single track railways that dates back to the last century. Under this system, single lines are divided into sections of varying lengths, signalboxes at the crossing — sections of double track on which trains may pass. Of course, it is essential that only one train at a time is admitted to any single track section, and this is assured by electromechanical apparatus interlocked with the signalling equipment.

Authority To Proceed

Before he can proceed into a single track section, the drain driver must receive from the signalmen a metal token or authority. No more than one such token can be released from the key token instruments in the signalboxes at each end of the single track section, and only when that token has been freed electrically from the next signalbox can the signalman clear his signals for the train to proceed. Until the token is replaced in the machine at the next crossing loop, no other token can be released, and no train movement can be signalled from either direction.
Communication between signalmen and their key token instruments is achieved electrically by the use of bell codes and currents passing in an openwire pole route. The system has been proved over many years, and is widely used in countries where there was strong British influence in railway development. Its drawbacks are the need for a signalman at every crossing loop, and the burden of maintaining pole routes in unfavourable conditions. Both are costly.
The RETB system was developed by British Rail's Director of Signalling & Telecommunications Engineering, in conjunction with the Research & Development Department at Derby, and with some financial assistance from the European Community. Equipment was supplied by Westinghouse Signals.
Recent developments in microprocessor technology and mobile radio have been harnessed to create a signalling system with built-in safety and security devices that give an overall level of safety as high as that of the key token system it replaces. There is no longer any need for lineside signalling or communications equipment, or for a signalman at each crossing loop. The entire route from Dingwall — to the northwest of Inverness — to the Kyle of Lochalsh is now controlled by one signalman located at Dingwall. Crossing loops at Garve, Achnasheen, Strathcarron, and Kyle of Lochalsh itself are unmanned. In all, a drastic reduction in both staff and infrastructure costs has been achieved.
The signalman at Dingwall communicates with train drivers over a radio link. This also provides communication between the signalbox microprocessor interlocking equipment and the train-borne receiver, which again is microprocessor based. When a train is ready to enter a single track section, for example from the junction at Dingwall to the first crossing place at Garve, coded messages are exchanged over the radio between the driver and signalman.
The driver requests authority to proceed to Garve and, once the microprocessor interlocking has proved the line clear, he receives it in the form of an electronic display on the small receiver mounted in his cab, showing the words "Dingwall" and "Garve". This is his electronic token, which remains illuminated until the driver "returns" it to the signalman when he is safely inside the loop at Garve. The integrity of the message that passes by radio between signalbox and locomotive, as well as the assurance that the message goes only to the train for which it is intended, is achieved by transmitting the locomotive address and associ-

The signalman at Dingwall with his keyboard and track diagram.

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elektor datacard — transistors BC516 & BC517

type	characteristics		limits	
BC516 p-n-p-darlington transistor for use in AF driver stages	Collector cut-off current, $-I_{CBO}$ ($-U_{CB}=30$ V)	≤ 100 nA	$-U_{CBO}$	40 V
	Collector-emitter saturation voltage, $-U_{CE(sat)}$ ($-I_C=100$ mA; $-I_B=0.1$ mA)	≤ 1 V	$-U_{CEO}$	30 V
	Base-emitter saturation voltage, $-U_{BE}$ ($-I_C=10$ mA; $-U_{CE}=5$ V)	≤ 1.4 V	$-U_{EBO}$	10 V
	Current gain — bandwidth product, f_T ($-I_C=10$ mA; $-U_{CE}=5$ V)	220 MHz	$-I_{CAV}$	400 mA
	DC current gain, h_{FE} ($-I_C=20$ mA); $-U_{CE}=2$ V)	≥ 30 000	P_D	625 mW
			T_j	150 °C
			θ_{ja}	200 K/W
			θ_{jc}	90 K/W
BC517 n-p-n-darlington transistor for use in AF driver stages	Collector cut-off current, I_{CBO} ($U_{CB}=30$ V)	≤ 100 nA	U_{CBO}	40 V
	Collector-emitter saturation voltage, $U_{CE(sat)}$ ($I_C=100$ mA; $I_B=0.1$ mA)	≤ 1 V	U_{CEO}	30 V
	Base-emitter saturation voltage, $U_{BE(sat)}$ ($I_C=10$ mA); $-U_{CE}=5$ V)	≤ 1,4 V	U_{EBO}	10 V
	Current gain — bandwidth product, f_T ($I_C=10$ mA; $U_{CE}=5$ V)	220 MHz	I_{CAV}	400 mA
	DC current gain, h_{FE} ($I_C=20$ mA; $U_{CE}=2$ V)	≥ 30 000	P_D	625 mW
			T_j	150 °C
			θ_{ja}	*200 K/W*
			θ_{jc}	90 K/W
D18	data are valid only under the conditions stated in brackets			

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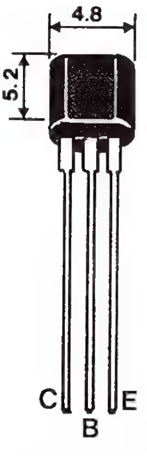


dimensions in mm

BC516 is complementary to BC517.

DC current gain, h_{FE} ($-I_C = 20$ mA; $-U_{CE} = 2$ V)		
	BC516-1	≥ 10 000
	BC516-2	≥ 20 000
	BC516-3	≥ 25 000

The value given overleaf for the total device dissipation, P_D, is applicable at ambient temperatures of up to 25°C: at higher temperatures, this value should be derated at 5 mW/°C.

D18

electronics select

ated information in the form of a data telegram. Each cab receiver unit has a unique, four digit number for verbal recognition and display purposes, and the data telegram is subjected to rigorous and sophisticated coding techniques to ensure that any corruption of the original message causes the telegram to be rejected by the receiving microprocessor.
The signalman has in front of him a keyboard unit and a visual display of the whole line. This shows him which sections are occupied, with the four digit receiver number appearing for identification purposes. A teleprinter records all keyboard entries, and voice traffic between signalman and drivers is tape recorded.

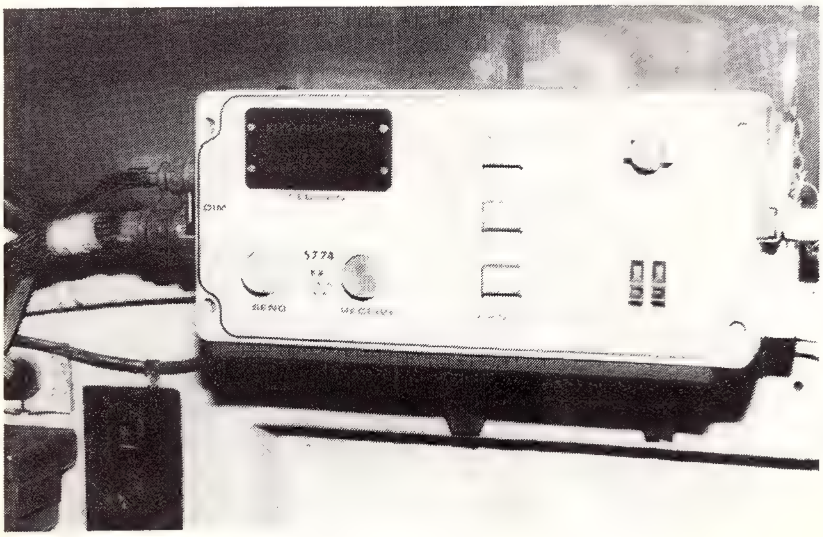
Enormous Benefit

The two way radio, of course, is available for communications at any time, and this is likely to be of enormous benefit on a remote railway where formerly the only means of communication for drivers was face-to-face with signalmen at the crossing stations. As with any radio communications system, strict attention is paid to the use of correct — and limited — terminology in voice traffic.
With the signalman eliminated at crossing loops, one problem remained to the RETB planners. Who would operate the loop points? In fact, this has been solved in the simplest way, by making the points trailable. Points at each end of the loop are held securely in position for the direction of travel, aligned for the left-hand track of the double line section.
This is done by pre-pressurized, hydropneumatic rams, which also allow the point blades to be pushed over, or trailed, by the wheels of a train moving in the opposite direction and leaving the passing loop. When a trailing movement is complete, the ram slowly restores the blades to their correct position for the next incoming train. An electronic detector proves complete closure of the point blades, at the same time actuating a yellow light indication to the driver that the points are correctly set.
As a train on a single line section approaches a passing loop, the driver first sees a reflective warning board, located at braking distance from the points indication signal. This allows him to come to a stop before the points should the signal not be displaying its yellow proceed indication. At the far end of the loop, protecting the trailing points, he encounters a reflective board bearing the words: "STOP — obtain token and permission to proceed." Here the token request sequence begins again.

Automatic Crossings

After a trial period of working alongside the key token system, the RETB equipment took over completely in October 1984 and has proved thorougly satisfactory in operation. The entire installation will be completed later this year with the conversion of the seven manned level crossings to automatic open crossings with flashing warning lights.
Already British Rail has obtained approval to extend the RETB system to the line north from Dingwall to Wick and Thurso, which is a much longer route with more crossing loops. A version is also going into service later this year on the East Suffolk line in eastern England, where RETB is providing an economic means of singling a double track route that has more than 20 level crossings.
The ability of the RETB system to cut operating costs is a highly significant development, and should ensure wider application of the equipment over the next few years. However, the economic implications extend far beyond British shores. The key token system is still in use on many main lines outside Europe and North America, often in inhospitable climatic and geographic conditions that make pole route maintenance a nightmare. British Rail's achievement of a simple, microprocessor based interlocking for single lines should find a ready export market.
Once installed, the RETB equipment allows far greater flexibility in planning train movements than was possible with signalmen working fixed shifts. Although the Kyle of Lochalsh service consists of only three trains each way daily, the new system makes it possible to schedule extra trains to run at any time, whithout the need to arrange for costly overtime by signalmen.

Chris Bushell — LPS (998 ES)


The electronic token appears on the driver's cab display.

Did you know...

...that an estimated 75 per cent of all computer errors have been found to be the result of disturbances in the mains electricity supply? These irregularities are caused either by the generating authority or by local factors, such as heavy motor starting or severe weather conditions. They affect electronic equipment because the sudden increase or decrease in mains voltage or frequency can be read as an operational signal or as a malfunction.

and also...

...that there is a British Amateur Electronics Club and an Amateur Computer Club? Both clubs publish a regular newsletter and operate a *readers letters* service.

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26 Forrest Road
Pennarth
South Glamorgan
Telephone: (0222) 707813

The Amateur Computer Club can be contacted at
Andy Leeder
Church Farm
Stratton St Michael
Norwich NR15 2QB

elektor electronics
september 1985

J Steeman

The name RS232 represents a number of standard conventions that aim to ensure the correct transfer of data irrespective of the individual characteristics of a computer. Most computers have a serial input & output port for connecting a printer, a DCE (Data Circuit Terminating Equipment), or even another computer. To marry the two, we have designed an RS232 card, which is intended for the universal I/O bus featured in the May 1985 issue of *elektor electronics*. There is a choice of TTL or RS232 line levels.

RS232 interface

serial transfer via the universal I/O bus

Parallel transfer of data, whereby all bits of a character are transferred simultaneously, is normally used where the distance between the computer and the peripheral equipment is relatively short. This means that a wire connection is required for each of these bits. This is a very reliable method of transfer, but if longer distances are involved, it becomes prohibitively expensive.

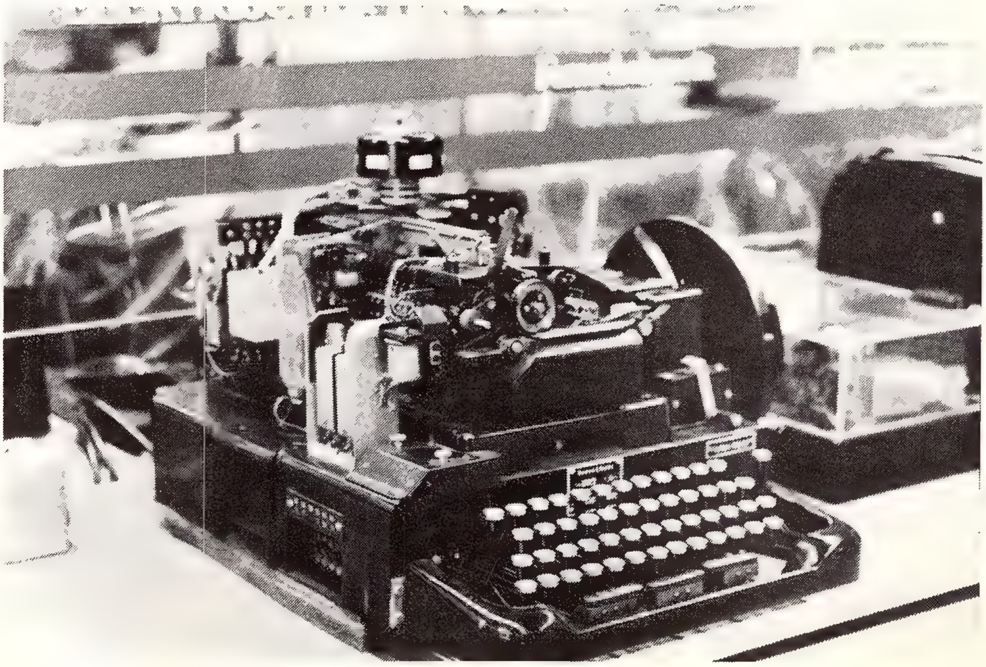
Another form of data transfer is used where other than relatively short distances are involved: serial, whereby all data are transferred in sequence over one transmission line. Compared with parallel transfer, the serial form requires a rather more complex receiver and transmitter, but the connection between the various parts of the computer system remains simple. And, of course, in case of wireless data transfer, serial transmission and reception remain the most practical method.

RS232 protocol

Transfer of data between a computer and a public network or in-plant installation is carried out by a Data Terminal Equipment <DTE> which is part of the computer system and a Data Circuit Terminating Equipment <DCE> popularly called a modem, which is connected to a transmission line. See Figure 1.

The exchange of data between the DTE and DCE must be governed by clear agreements as to their format. For instance, as the bits are transmitted sequentially, their timing and that of the complete characters must be accurately known.

There are two types of transfer: synchronous and asynchronous. In the former, a continuous data stream is transmitted, and the receiver is synchronized to the transmitter by a clock signal derived from the data, or by a specially transmitted clock signal. Asynchronous transmission is, however, far more commonly met. This method has its origin in telex engineering. Since the drive motors of the transmit and receive terminals could not be synchronized precisely over long periods, each group of data bits was preceded by a start bit and closed by a stop bit. This type of



1

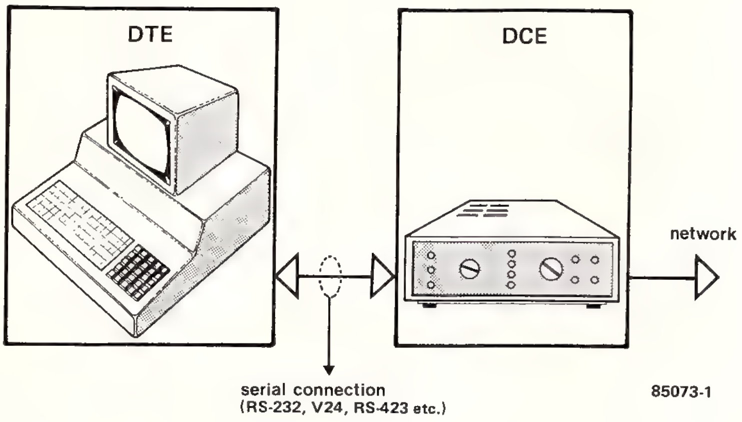


Figure 1. Generally, an RS232 or a V24 connection is used for communication between a DTE (Data Terminal Equipment) and a DCE (Data Circuit Terminating Equipment).

2

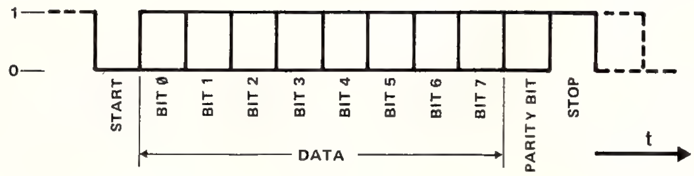


Figure 2. General shape of a serial data word, here preceded by a start bit and followed by a parity bit and optional stop bit.

synchronization is perfectly satisfactory for the relatively short duration of the data word.

An example of such a serial signal is shown in Figure 2. First is the start bit, followed by eight data bits (for instance, an ASCII character), a parity bit for error control, and finally the stop bit. The stop bit enables checking whether the transmission and reception speeds are the same.

The correct processing of the data stream exchanged between the DTE and DCE is based on a protocol, i.e., a set of conventions or regulations. The two most common, official protocols are the RS232 and the V24.

Apart from the data, there is a number of signals for the individual control of the DTE and the DCE. All these and the relevant connection to a standard D-type connector are shown in Figure 3.

DTR, DSR, and DCD are typical signals used for the establishing and terminating of a communication. The remaining signals are used, as required, during the exchange.

Assuming the communication is full duplex, i.e., both the T×D and R×D lines are in use, the DTE activates the DTR line to indicate a request for communication. The modem responds to this by activating the DSR line. If the DTE is to transmit, it activates the RTS line. The DCE acknowledges that it can process the data by activating the CTS line. Note that in full duplex operation the DTE can also receive at all times, provided that the modem has activated the DCD line. This takes place during the establishment of the communication. See also *data communication by telephone* and *direct-coupled modem* in the September and October 1984 issues of *elektor electronics* respectively. The "secondary" connections are relevant to the main channel — back channel separation in modems.

Translating all these actions to a ready-to-use serial connection to a computer is effected by an intelligent peripheral chip: asynchronous communications interface adapter (ACIA) Type 6551. This device is simply accommodated in the microprocessor system to provide complete RS232 and V24 compatible communication with the outside world.

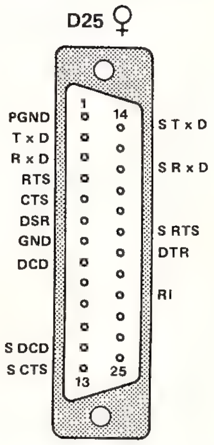
Interface circuit

As may be seen from Figure 4, the ACIA does not need much more than a crystal and a number of gates for signal level matching to carry out its task. To the left of it are shown the usual connections to the computer system: here, the slot connections of the I/O bus.

The 1843.2 kHz crystal connected to pins 6 and 7 is used to provide a number of baud-rates, which are selected by the software. The R×C pin (5) is a bidirectional input and output respectively for an external clock to provide non-standard baud-rates, and for outputting the internal baud-rate generator. In either case, the clock frequency amounts to sixteen times the baud-rate.

To the right of IC_1 are the familiar RS232 lines with buffered inputs and outputs. Seen from the IC, all signals are inverted, which means that all control signals: DTR, RTS, CTS, DCD, and DSR are active high, whereas data signals $\overline{T \times D}$ and $\overline{R \times D}$ are active low. These levels are standard for

3



PGND	protective ground
T x D	transmit data
R x D	receive data
RTS	request to send
CTS	clear to send
DSR	data-set ready
GND	ground
DCD	data carrier detect
DTR	data-terminal ready

S DCD	secondary data carrier detect
S CTS	secondary clear to send
S T x D	secondary transmitted data
S R x D	secondary received data
S RTS	secondary request to send
RI	ring indicator

Figure 3. Standardized RS232 connections to a 25-way D-type connector. The "secondary" connections and the RI connection are only used at the DCE side.

4

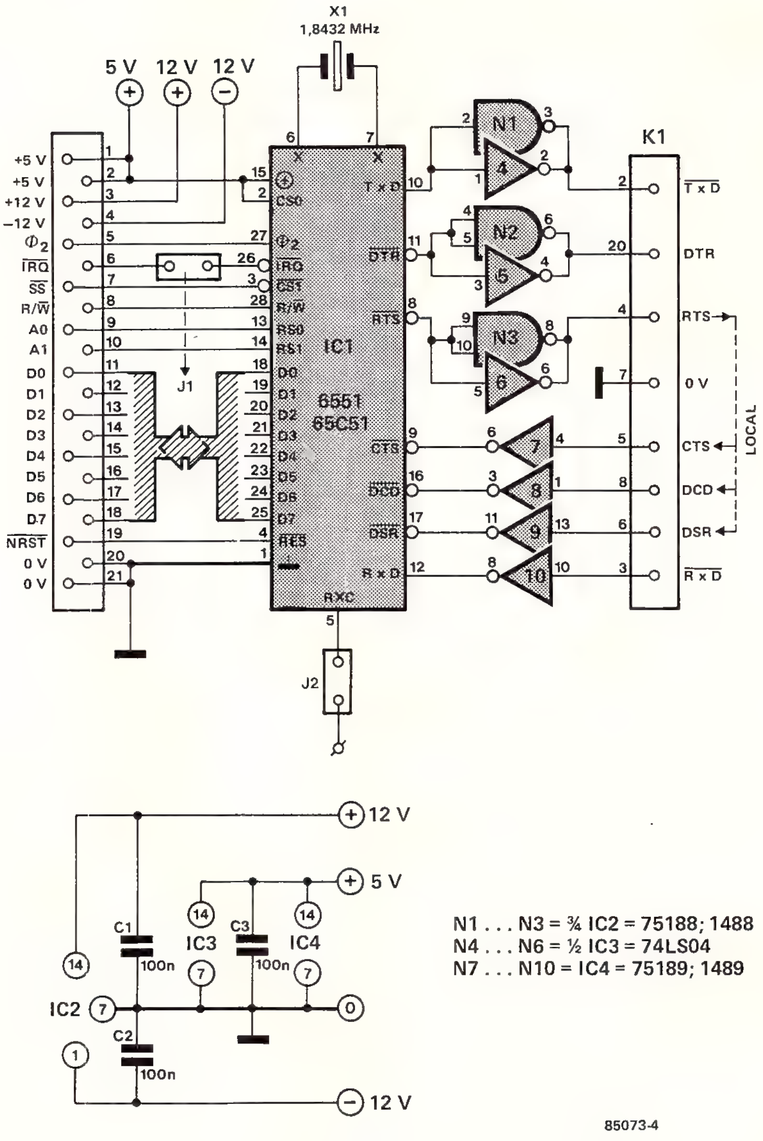


Figure 4. Circuit diagram of the RS232 card. Links J_1 and J_2 are optional. Either RS232 drivers N_1. . . N_3 or TTL drivers N_4. . . N_6 are used.

RS232 connections. There are two possible, corresponding voltage levels: TTL, i.e., high = +5 V; low = 0 V, and RS232, i.e., high = +3 . . . +25 V (nominally 12 V) and low = —3 . . . —25 V (nominally —12 V). It is intended that one of the groups of parallel-connected ports is selected: N_1. . . N_3 provide RS232 levels, and N_4. . . N_6, TTL levels. The receive buffers are suitable for both TTL and RS232 levels. It is, therefore, necessary to check with which levels the system to be connected operates. The printed-circuit board in Figure 5 shows both IC_2 and IC_3, which are required for TTL or RS232 levels respectively. The ±12 V supply is not needed in TTL operation.

Operation

As stated, the circuit is based on a Type 6551 ACIA, a block diagram of which is given in Figure 6. Communication at the DTE end is effected by five registers, four of which are detailed in Figure 7. Since the inputs are connected to address lines A_0 and A_1, the registers are located sequentially in the address range of the I/O bus. If, for instance, the interface card is placed in slot 1 of the universal I/O bus, and the start address of the I/O range is set to 4000_{hex}, the Transmit and Receive Data Registers are at 4000_{hex}, the Status Register at 4001_{hex}, the Command register at 4002_{hex}, and the Control Register at 4003_{hex}.

Transmit and Receive Data Registers

During transmission, bit 0 (LSB) is sent first. The bits not used, for instance, 5 . . . 7 where a 5-bit format has been chosen, are treated as "don't care". In the receive mode, the first received bit goes to location 0, and subsequent bits to 1, 2, and so on. The highest, not used, locations are given a 0.

Status Register

This register can only be read. Bits 0, 1, and 2 indicate respectively whether during reception errors in parity, framing, or overrun occurred. The more important bits

5

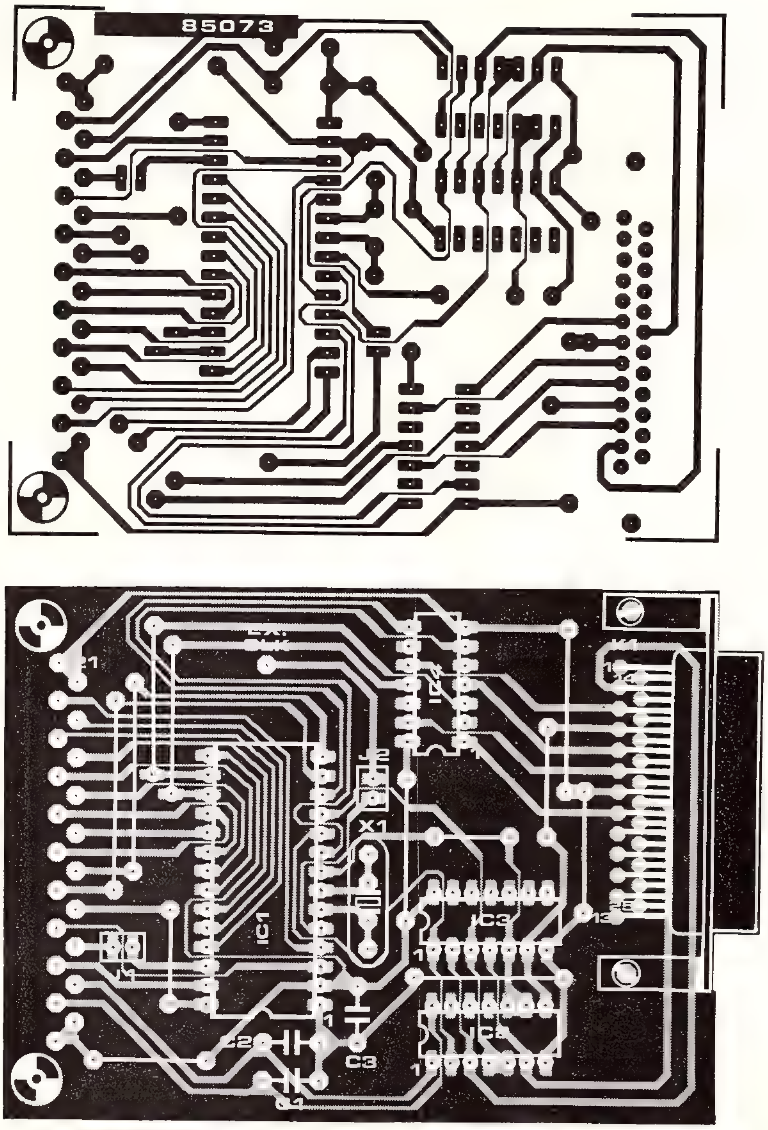


Figure 5. The printed-circuit board of the RS232 card with at one side the connector that slots into the universal I/O bus, and at the other side the standard D-type RS232 connector.

Parts list

Capacitors:
$C_1 \dots C_3$ = 100 n

Semiconductors:
IC_1 = 6551; 65C51
IC_2 = 75188; 1488
IC_3 = 74LS04
IC_4 = 75189; 1489

Miscellaneous:
X_1 = crystal, 1843.2 kHz
K_1 = 25-way D-type subminiature connector; right-angled; female
21-way right-angled connector; male; to DIN41617
two 2-pin pcb type terminal block

6

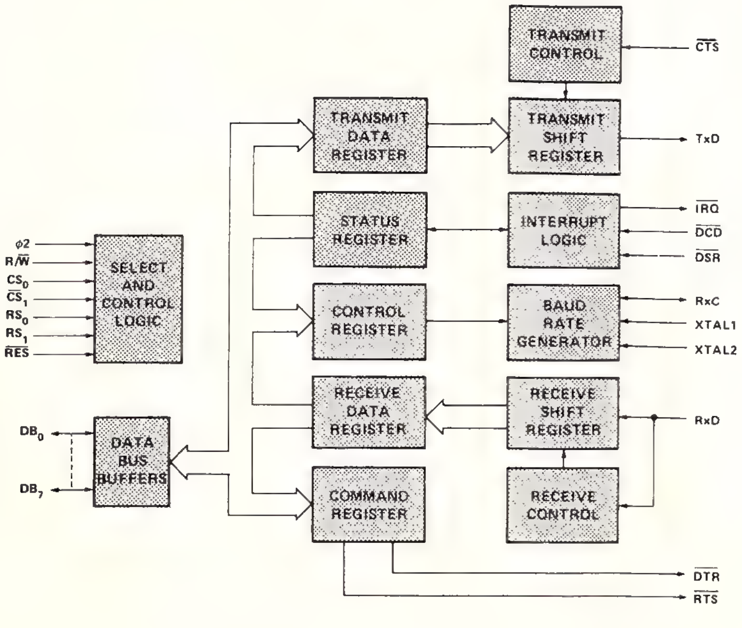
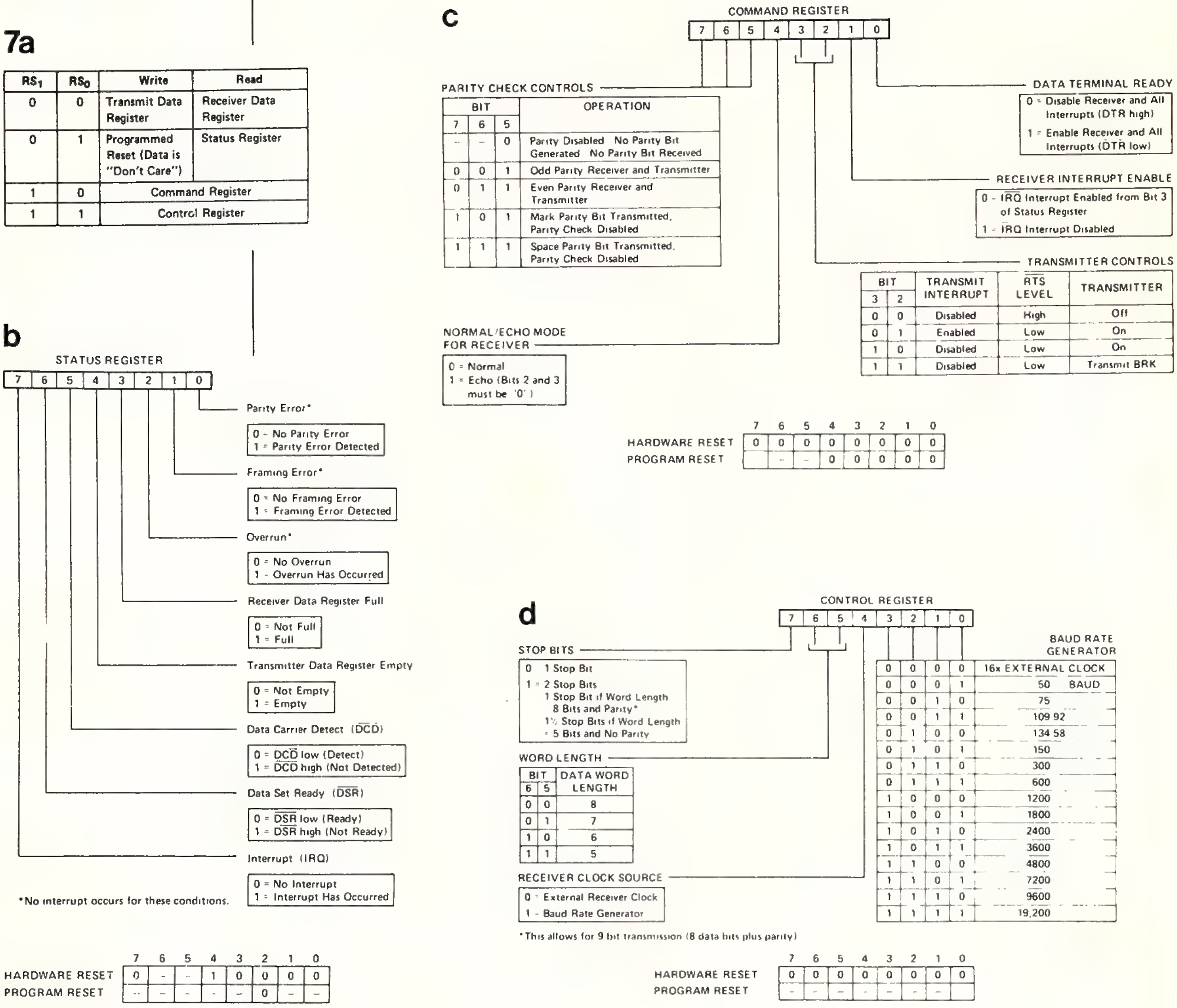


Figure 6. Block diagram of ACIA Type 6551.



7a

RS$_1$	RS$_0$	Write	Read
0	0	Transmit Data Register	Receiver Data Register
0	1	Programmed Reset (Data is "Don't Care")	Status Register
1	0	Command Register	
1	1	Control Register	

b

STATUS REGISTER
7 6 5 4 3 2 1 0
Parity Error*
0 = No Parity Error
1 = Parity Error Detected
Framing Error*
0 = No Framing Error
1 = Framing Error Detected
Overrun*
0 = No Overrun
1 = Overrun Has Occurred
Receiver Data Register Full
0 = Not Full
1 = Full
Transmitter Data Register Empty
0 = Not Empty
1 = Empty
Data Carrier Detect ($\overline{DCD}$)
0 = $\overline{DCD}$ low (Detect)
1 = $\overline{DCD}$ high (Not Detected)
Data Set Ready ($\overline{DSR}$)
0 = $\overline{DSR}$ low (Ready)
1 = $\overline{DSR}$ high (Not Ready)
Interrupt (IRQ)
0 = No Interrupt
1 = Interrupt Has Occurred

*No interrupt occurs for these conditions.

	7	6	5	4	3	2	1	0
HARDWARE RESET	0	-	-	1	0	0	0	0
PROGRAM RESET	-	-	-	-	-	0	-	-

c

COMMAND REGISTER
7 6 5 4 3 2 1 0
PARITY CHECK CONTROLS
DATA TERMINAL READY
0 = Disable Receiver and All Interrupts (DTR high)
1 = Enable Receiver and All Interrupts ($\overline{DTR}$ low)
RECEIVER INTERRUPT ENABLE
0 - $\overline{IRQ}$ Interrupt Enabled from Bit 3 of Status Register
1 - $\overline{IRQ}$ Interrupt Disabled
TRANSMITTER CONTROLS
NORMAL/ECHO MODE FOR RECEIVER
0 = Normal
1 = Echo (Bits 2 and 3 must be '0')

BIT 7	BIT 6	BIT 5	OPERATION
-	-	0	Parity Disabled No Parity Bit Generated No Parity Bit Received
0	0	1	Odd Parity Receiver and Transmitter
0	1	1	Even Parity Receiver and Transmitter
1	0	1	Mark Parity Bit Transmitted, Parity Check Disabled
1	1	1	Space Parity Bit Transmitted, Parity Check Disabled

BIT 3	BIT 2	TRANSMIT INTERRUPT	$\overline{RTS}$ LEVEL	TRANSMITTER
0	0	Disabled	High	Off
0	1	Enabled	Low	On
1	0	Disabled	Low	On
1	1	Disabled	Low	Transmit BRK

	7	6	5	4	3	2	1	0
HARDWARE RESET	0	0	0	0	0	0	0	0
PROGRAM RESET		-	-	0	0	0	0	0

d

BIT 6	BIT 5	DATA WORD LENGTH
0	0	8
0	1	7
1	0	6
1	1	5

3	2	1	0	BAUD RATE GENERATOR
0	0	0	0	16x EXTERNAL CLOCK
0	0	0	1	50 BAUD
0	0	1	0	75
0	0	1	1	109 92
0	1	0	0	134 58
0	1	0	1	150
0	1	1	0	300
0	1	1	1	600
1	0	0	0	1200
1	0	0	1	1800
1	0	1	0	2400
1	0	1	1	3600
1	1	0	0	4800
1	1	0	1	7200
1	1	1	0	9600
1	1	1	1	19,200

*This allows for 9 bit transmission (8 data bits plus parity)

	7	6	5	4	3	2	1	0
HARDWARE RESET	0	0	0	0	0	0	0	0
PROGRAM RESET	-	-	-	-	-	-	-	

Figure 7. Details of the registers used to program the ACIA.

are, however, 3 and 4, which indicate whether a complete character has been sent or received. These bits determine in the control program whether the next character can be processed. The final three bits enable the reading of the DCD and DSR lines and of the interrupt status. If an interrupt structure is used for the control of the interface card, the status register must be checked after detection of an interrupt to decide what the next operation should be. If such a structure is not used, link J$_1$ should be left open; the interrupt is then still generated but not passed on to the computer system.
An arbitrary write operation to the Status Register gives rise to a program reset. The effect of such a reset is indicated in Figure 7 for each register. A dash indicates indeterminate.

Command Register

Bit 0 determines the DTR signal and the receiver status. Bit 1 is used to decide whether an interrupt indicating a full Receive Data Register should be given or not. Bits 2 and 3 control the RTS signal and, therefore, the operation of the transmitter. They are also used to decide whether an interrupt indicating an empty Transmit Data Register should be given or not. Bit 4 is normally 0. Bits 5...7 are used for parity control and control of the transmitter and the receiver.

Control Register

This register determines the format of the serial data. Bits 0...3 determine the baud-rate: there is a choice of a number of standard baud-rates, all derived from the crystal frequency. In position 16× external clock, an external clock signal may be applied to pin 6 of IC$_1$ (pin 7 open): the baud-rate will be one sixteenth of the external frequency. The internal baud-rate generator is connected to the receiver when bit 4 is logic 1: transmitter and receiver then work at the same baud-rate, while pin 5 of IC$_1$ functions as the output terminal of the internal generator; the frequency is sixteen times the selected baud-rate. This arrangement makes it possible to connect several ACIAs in tandem. When bit 4 is logic 0, pin 5 functions as the input for the receiver clock via bridge J$_2$. Bits 5 and 6 determine the

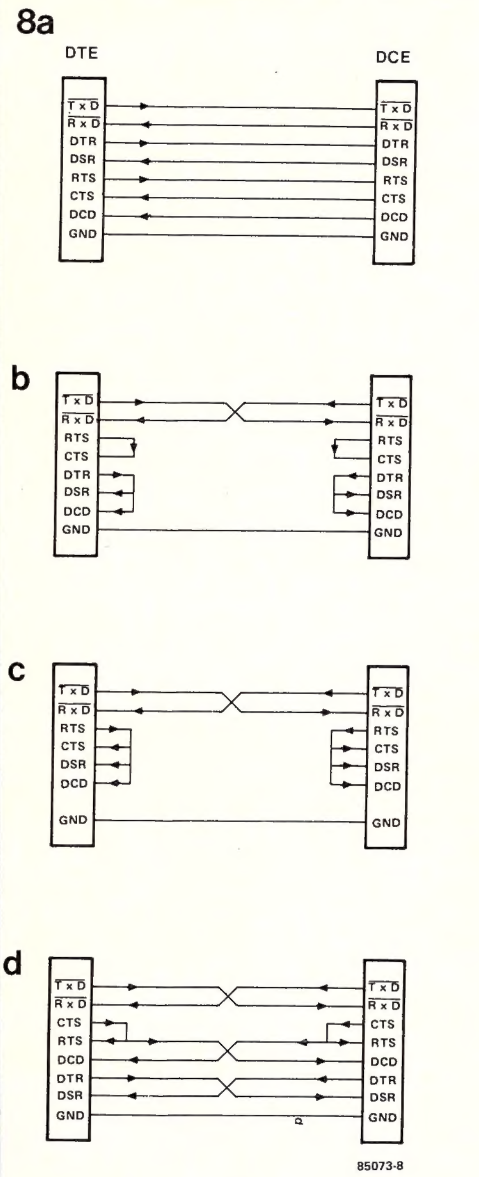


Figure 8. Some examples of RS232 connections: b...d are intended for use between two DTEs.

length of the data word. Bit 7 enables selection of 1, 1½, or 2 stop bits.

It is clear that there are a great number of programming possibilities. With a little knowledge of machine language and some experience in this type of work, almost anyone can establish his own specific serial connections.

As far as connections to peripheral equipment are concerned, distinction should be made between DTE-DCE (interface card — modem) and DTE-DTE (interface card — another computer, terminal, or printer) combinations. In the latter, the connecting cable must make it possible that the func-ion of the DCE is simulated as far as easible. Figure 8 gives a number of examples of the connection between the nterface card and peripheral equipment: n a the peripheral equipment is a modem; in b...d the modem function of he connected unit is more or less simulated by the cable connection. Figures 8b and 8c are simple versions of he so-called cross or zero-modem connections, whereby the transmit and receive data lines are interconnected crossways, while the two systems generate their own control signals. Any control characters are exchanged via the data lines. The local mode connection illustrated in 8c is most suitable for the present 6551 card. Rather more control signals are used in the arrangement shown in 8d. The mutual DTR-DSR interchange is effected at start-up. When one unit gives RTS, thereby effecting its own CTS, the other activates DCD, so that it switches to the receive mode. How the various connections are made is, therefore, entirely a matter of application. The sample program shown is a simple RTTY receive program for the present card. It was originally intended for the Acorn Atom, but is easily adapted for use with any 6502 computer (which must, of course, be fitted with the universal I/O bus and the present interface). ◀

A simple RTTY receive program for the Acorn Atom.

```
 10 REM RTTY-ONTVANGPROGRAMMA VOOR ACORN ATOM
 20 REM 6551-BASIS-ADRES=#4000...#4003
 30 DIMVV14;FORA=0TO13;VVA=-1;N.
 40 DIMLL8;FORB=0TO7;LLB=-1;N.
 50 P.$12;P.$21
 60 F.C=0TO1;P=#3500
 70
 80 [
 90:LL0 LDA@#0B;STA#4002 \initialise
100      LDA@#F1;STA#4003
110      LDA@0;STA#80;STA#81;STA#85;STA#90
120      LDA@#C0;STA#91
130      LDA@#81;STA#92
140:LL1 JSR#FE71           \keyscan
150      CPY@#11;BNE P+7
160      LDA@#F1;STA#4003
170      CPY@#12;BNE P+7
180      LDA@#F2;STA#4003
190      CPY@#2E;BNE P+6
200      LDA@#00;STA#80
210      CPY@#33;BNE P+6
220      LDA@#01;STA#80
230      CPY@#35;BNE P+6
240      LDA@#FF;STA#80
250:LL2 LDA#4001;AND@#08;BEQ LL2 \receive-register full?
260      LDA#4000;TAY
270      CMP@#02;BEQ LL3;CMP@#08; BEQ LL3 \cr or lf?
280      CMP@#1F;BEQ LL4 \lets?
290      CMP@#00;BEQ LL4 \3rd shift?
300      CMP@#1B;BEQ LL5 \figs?
310      CMP@#04;BNE LL6 \space?
320      LDA#80;BEQ LL6
330      CMP@#01;BNE LL7
340      LDA@#20;STA#81;JMP LL6
350:LL7 LDA@#00;STA#81
360:LL6 TYA;CLC;ADC#81;TAY
370      LDA#8400,Y;JSRVV5;JMP LL1 \output to video-driver(vv5)
380:LL3 CLC;INC#85;LDA#85;CMP@#02;BNE LL1 \cr/lf-loop
390      LDA@#00;STA#85;LDA@#0D;JSRVV5;JMP LL1
400:LL4 LDA@#00;STA#81;JMP LL1 \setlet
410:LL5 LDA@#20;STA#81;JMP LL1 \setfig
411
412 \VIDEO-DRIVER
413
420:VV5 TAY;BEQVV1;CMP@#0D;BNEVV13;LDX@#20;STX#90;LDY@#20;TYA
430:VV13JSRVV11;JSRVV2
440:VV1 RTS
450:VV11TAX;CLC;ADC@#C0;BCCVV12;TXA;EOR@#40;RTS
460:VV12TXA;RTS
470:VV2 LDY#90;STA(#91),Y;INY;CPY@#20;BCCVV3;JSRVV4;LDY@#00
480:VV3 STY#90;RTS
490:VV4 LDA#91;LDY#92;CPY@#81;BCCVV6;CMP@#0E;BCCVV6;LDY@#20
500:VV7 LDA#8000,Y;STA#7FE0,Y;INY;BNEVV7
510:VV8 LDA#8100,Y;STA#80E0,Y;INY;BNEVV8;LDY@#1F
520:VV9 STA(#91),Y;DEY;BPLVV9;RTS
530:VV6 ADC@#20;STA#91;BNEVV10;INC#92
540:VV10RTS
560
570]
580 N.C;P.$6
590 REM lookup-table
600 D=#8400
610 D! 0=#410A4500;D! 4=#55495320;D! 8=#4A52440D;D!12=#4B43464E
620 D!16=#574C5A54;D!20=#51505948;D!24=#0047424F;D!28=#0056584D
630 D!32=#2D0A3300;D!36=#37382720;D!40=#0734240D;D!44=#283A002C
640 D!48=#32292B35;D!52=#31303600;D!56=#00003F39;D!60=#003D2F2E
650P.''"  RTTY"'"  ===="'"1=50 BD"'"2=75 BD"'"N=NORMAL"
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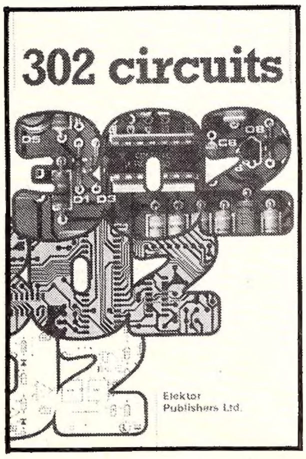

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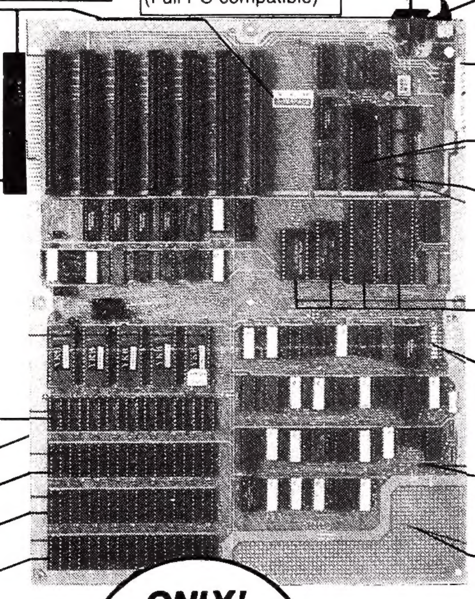

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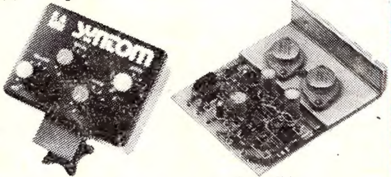

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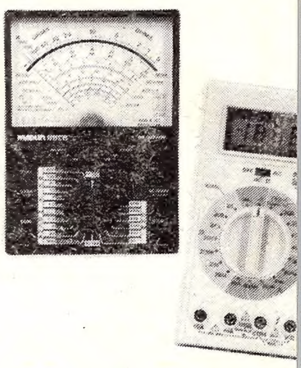

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